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VIEW FROM THE BRIDGE

"A 'Graphics Extravaganza?' " Michael Schneider asked when I showed him this month's cover headline. "A couple of programs and a tutorial doesn't make it an 'extravaganza.' If I'm going to call it a 'graphics extravaganza,' it had darn well better be a 'graphics extravaganza.' "

Having a publisher with ethics is a constant source of difficulty, but one the shrewd editor can live with through careful planning. In this case, careful planning involved bringing along the full lineup of graphics articles in this month's *Ahoy!* One by one I laid them on his desk.

"Look, Mike," I said, "*Screen Magic* by Bob Spirko, who wrote *Alice in Adventureland* for us a few months back. It provides a joystick-controlled palette and canvas for creating color graphics on the 64, without all the complicated commands.

"And *Screen Dumping on the Commodore 64*—a real education in creating screen bit graphics. It would have to be. It was written by Professor Roger S. Macomber of the University of Cincinnati. The program he includes uses machine language to speed up the dumping of graphics to a printer.

"Dale Rupert covered screen bit graphics in this month's *Rupert Report*, too—but *The Ultimate Resolution* concentrates on the theory behind practical applications like Prof. Macomber's.

"Here's another example of how graphics theory can be put to use: J.M. Marcano's *Mapping 4.4*, which allows you to plot mathematical functions in hi-res."

Peering at me over the pile of manuscripts, Mike looked annoyed. I asked why.

"Because," he said, "you're standing here babbling when you've got a graphics extravaganza to put together!"

Gee, I thought as I left Mike's office—I didn't even get to tell him about this graphics issue's flagship piece: *Quad-Print* by Michael Beutjer. Mprton Kevelson will tell *you* all about this landmark program in his *Graphics Challenge Update* on the facing page.

Having justified our cover headline, we'll now do the same for the larger type on the cover—the *Ahoy!* logo—with the finest lineup of Commodore-related articles and programs you'll find on the newsstand this month:

• For Orson Scott Card to outdo himself would take some doing (outdoing?)—but he may have succeeded with this month's installment of *Creating Your Own Games on the VIC and 64.* In *Sing a Song of Anything,* he provides a system by which C-64 users can automatically enter music into their original game programs—as easily as typing letters! (Turn to page 18.)

• The third installment of *Commodore Roots,* Mark Andrews' assembly language programming column, peers *Under the Hood* of your computer at its microprocessor. Included is the *6510 Simulator,* a program which, while not an assembler, will show you how one works. (Turn to page 77.)

• *Duck Shoot* starts out as easy as the penny arcade version, but soon reaches a level of complexity certain to ruffle your feathers. (Turn to page 35.)

• *Towers of Hanoi* adapts the famous Tower of Brahma puzzle to the C-64 screen. (Turn to page 17.)

• Even the most expert joystickers will be thrown for a loss by *Speedy* for the unexpanded VIC 20. Its title character has a mind of his own when it comes to responding to your directions. (Turn to page 56.)

• Sheldon Leemon, author of *MACTALKS* and *Telecomputing on the IBM PC* from COMPUTE! Books, takes over at the helm of our *Ship to Shore* column this month with a technical overview of telecommunications. (Turn to page 29.)

• Also inside are Dale Rupert's *Commodares* at their most frustrating; *Scuttlebutt,* offering news in greater depth and more timely fashion than any other Commodore monthly; and *Reviews* of products like *Blue Max 2001, PROMAL,* and the Teknika MJ-10 color monitor.

Love to tell you more, but I have to run back to Mike's office. His secretary dropped a note on my desk—something about a "Graphics Super-Spectacular."

—David Allikas

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GRAPHICS CHALLENGE UPDATE

By Morton Kevelson

In the October 1984 issue of *Ahoy!*, as part of a tour de force on Commodore 64 bit mapped graphics, I issued a graphics challenge to all comers. In brief, I was looking for some way to manipulate a bit mapped graphics field which exceeded the limitations of a single 320 by 200 pixel Commodore 64 high resolution display. The response has been far from overwhelming, but some results are in.

The first answer came from Inkwell Systems, with version 4.0 of *Flexidraw*. Among the enhancements to version 3.0 (reviewed in November 1984) is the ability to link multiple screens on both the monitor and the printer. This allows for printouts made up of 544 pixels wide and an unlimited number of pixels high. (Look for a detailed review of *Flexidraw* version 5.0 later this year. This will have so many enhancements to version 3.0 that it is practically a new program.)

The second response comes from Michael Beutjer, author of *Picture Perfect* from KT Software (October 1984 *Ahoy!*). For those of you who have been unable to locate this versatile Koala screen dump program, it is now being sold as *KoalaPrinter* by Koala Technologies. Mr. Beutjer has responded to my challenge by providing the *Quad-Print* program in this month's issue. The two versions of this program will allow up to four *DOODLE!* files to be linked for simultaneous printout on a Gemini 10X or a Commodore 1526 printer.

Bit mapped graphics for the 1526 printer are difficult to implement, as it does not support true graphics mode. The 1526 allows for a single custom character to be defined and printed. Thus a full bit mapped screen dump requires the image to be formed eight bytes at a time. Furthermore, each time the custom character is redefined a carriage return without linefeed must be executed before it can be printed. This is what causes bit mapped screen dumps to print so slowly on the 1526.

For advanced users, the source code listings for the *Quad-Print* programs have been included. Owners of the 1526 should take note of the listing labeled *Fast Dump Routine*. Mr. Beutjer has used a clever trick to maximize the speed of the 1526 bit map printout. The single character is not redefined unless it is found to be different from the last one. As a result, this high resolution dump for the 1526 should be the fastest available from any source. □

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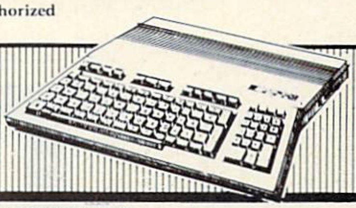
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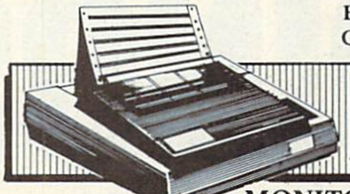
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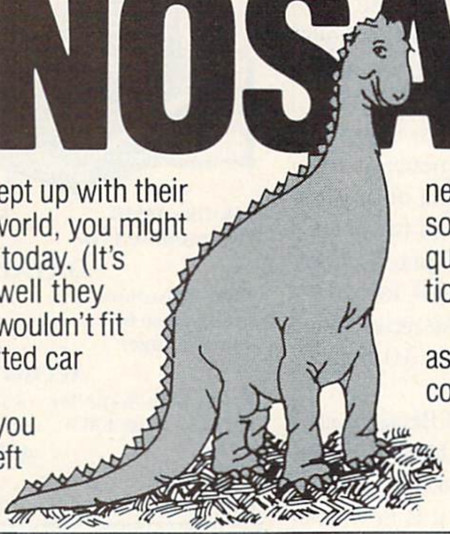
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Micro-W. Distributing, Inc., 1342B Route 23, Butler, NJ 07405 (phone: 201-838-9027).

RE G

When you review products prior to their release, as we try to do, announcements of this type are sometimes necessary. Cardco's OuiG interface (see page 88, April), their enhanced version of the +G, has been renamed the G Wiz. (Whatever the product's capabilities, you've got to be impressed by Cardco—coming up with not one, but two cute titles for a printer interface.)

Cardco, Inc., 300 S. Topeka, Wichita, KS 67202 (phone: 316-267-3807).



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DATABASE PROGRAMS

The icon-driven *E-Files 64* lets the user set up a customized database in card file format in any of three file drawers (each with a 200-record capacity). Sort and search by any user-defined field, selective printouts, and address book format with mailing labels are all possible. On disk; $20.95.

VMC Software, P.O. Box 326, Cambria Heights, NY 11411.

Designed to manage a home or small business bank account, *Mega-Base I* will scan a datafile for checks by number, company, or name, deposit listings and withdrawals, append or edit existing datafiles, auto-balance, and list a block of checks. On disk for the 64; $19.95.

Mega-Systems, P.O. Box 415, Spring House, PA 19477 (phone: 215-855-4451).

CHARACTER EDITORS

The uses of the *Chared* character editor range from creating character sets for the Greek (or any other) alphabet to designing flying saucers for game use. Hi-res and multicolor modes are supported. Two sample character sets are included. For the C-64 on tape ($19.95) or disk ($22.95).

APCAD Software, P.O. Box 2673, Ann Arbor, MI 48106.

Font Factory will read in any standard Commodore ASCII sequential disk file, automatically format it, and print the document with the typeface you select (eight are provided) in single or double width. On the same disk is *Signwriter 64,* allowing you to generate large letter signs up to 40 characters long, in characters up to 1 foot in length. Price is $29.95.

INTEGRATED SOFTWARE

If you multiply the hundreds of thousands of copies of *Lotus 1-2-3* that have been sold for the IBM PC by the program's selling price of $300-$500, it easily ranks as the best-selling computer program of all time. This success has inspired three manufacturers of C-64 software to produce their own integrated business software, wherein several programs reside simultaneously in memory, allowing data to be switched back and forth.

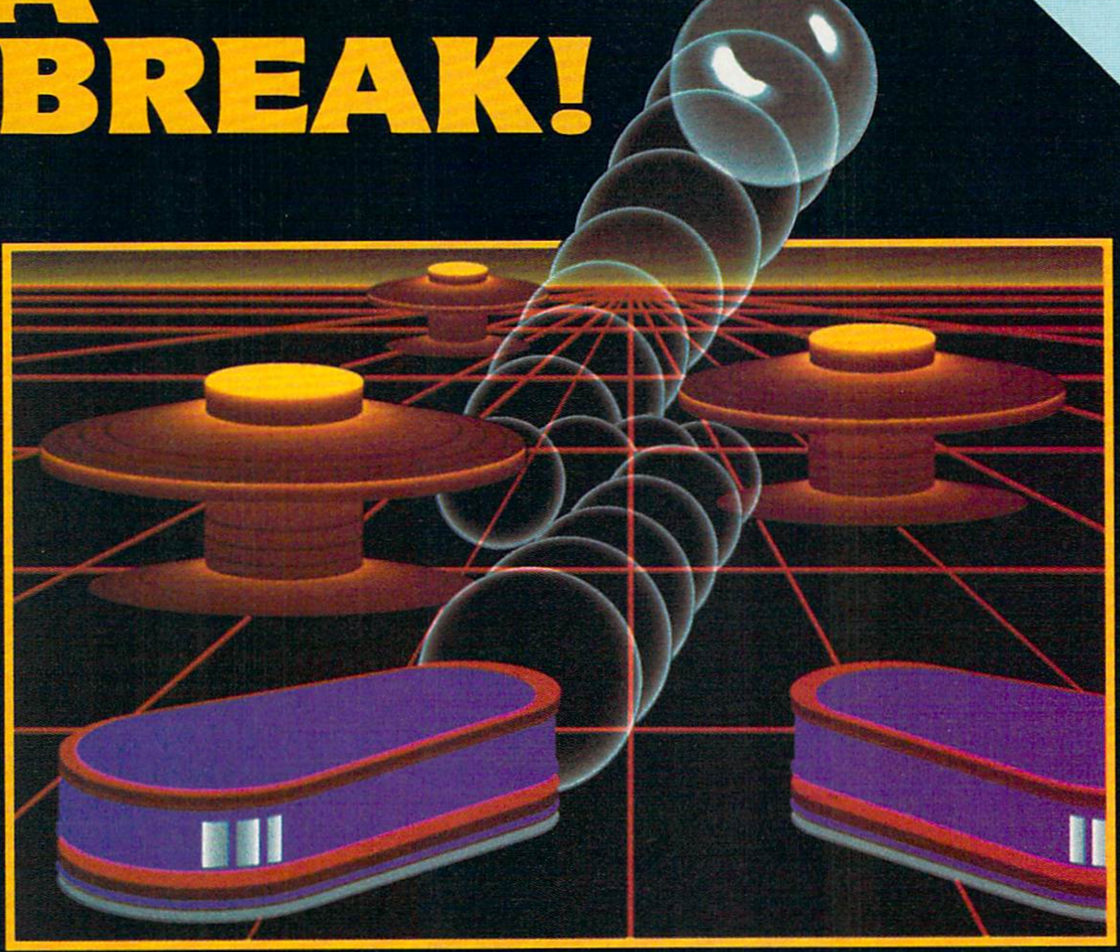
Vizastar, like *Lotus*, provides spreadsheet, database, and business graphics programs. Menu-driven, it allows you to open up to nine windows to view different parts of the spreadsheet simultaneously. As of this writing, the program will work only with the 1541 disk drive. Price is $119.97.

Solid State Software, 1253 Corsica Lane, Foster City, CA 94404 (phone: 415-341-5606).

Harmony from International Tri Micro also offers spreadsheet, database, and business graphics programs,

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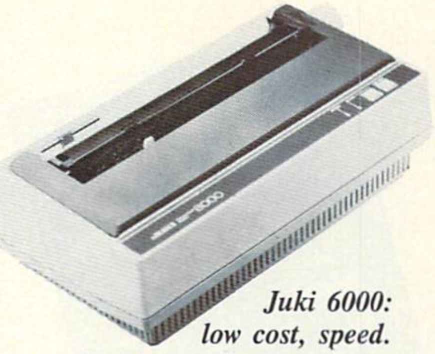
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and adds a word processor. A windowing feature allows the user to view one set of data while working with another.

International Tri Micro, 1010 N. Batavia, Suite G, Orange, CA 92667 (phone: 714-771-4038).

Softsync's *Trio* comprises word processor, spreadsheet, and database programs. The spreadsheet features 48K free memory and recalculates topologically, similarly to *Lotus 1-2-3* and *Multiplan.* On disk, with 120-page manual/tutorial; $69.95.

Softsync, Inc., 162 Madison Ave., New York, NY 10016 (phone: 212-685-2080).



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NEW PRINTERS

For the individual who must own the fastest printer on the block, Sakata's SP-1500 is a safe bet at 180 characters per second. Despite its high speed, the $585.00 serial impact dot matrix printer operates at a noise level of 60 dB(A). Included are a 3K buffer, friction/tractor and reverse feed, near letter quality mode and numerous other special print features, and built-in parallel Centronics interface (serial interface optional).

Sakata U.S.A. Corporation, 651 Bonnie Lane, Elk Grove Village, IL 60007 (phone: 312-593-3211).

If speed is not important but low-cost letter-quality print is, the $295 Juki 6000 will bang out 10 characters per second from a 100-character daisy wheel in 10, 12, or 15 pitch. Included are both Centronics parallel and RS-232C serial interfaces.

Juki Industries of America, Inc., 299 Market Street, Saddle Brook, NJ 07662 (phone: 201-368-3666).

64 AND PALS

64 and Pals' disk and booklet lead the beginning user from setting up his C-64 through running various types of programs. Price: $14.95.

Abnel Company, P.O. Box 397, Grand Junction, CO 81502 (phone: 303-245-3997).

TELECOM NEWS

Through *Travelshopper,* CompuServe subscribers can now directly access TWA's PARS reservations system to determine the lowest fares and most convenient flights—as well as make an immediate reservation and have the ticket sent to their home, the airport, or a designated travel agent. Enrollment is free and includes membership in TWA's Frequent Flight Bonus program. The TWA PARS includes up-to-date information on domestic and international flights for every published airline schedule in the world.

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CompuServe Inc., 5000 Arlington Centre Blvd., P.O. Box 20212, Columbus, OH 43220 (phone: 614-457-8600).

Guide to Modems, an 8-page pamphlet published by Anchor Automation, defines basic modem technology and its applications and provides suggestions for product selection (with an admirable lack of mention of their own product line). Copies are available at retailers.

Anchor Automation, Inc., 6913 Valjean Ave., Van Nuys, CA 91406.

VIP Technologies has replaced its *VIP Terminal* with *VIP Terminal XL,* compatible with the C-64 and 128PC and featuring X-Modem file transfer protocol (to allow transfer of files to and from information services using same). Price: $39.95.

VIP Technologies, 132 Aero Camino, Goleta, CA 93117 (phone: 805-968-4045).

Requiring only a C-64, a 1541 disk drive, and a 1526 printer, *CAM-64* (Call Accounting Manager) allows businesses to sort outgoing calls by station/extension (up to 254), area code, common carriers, and other categories, each of which may be subdivided into number of calls, length of calls, etc. Price of autostart cartridge, software, and manual is $295.

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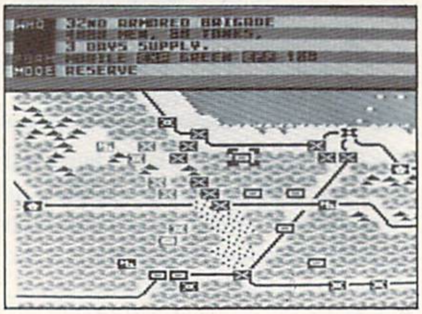
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Input Systems, Inc., 15600 Palmetto Lake Drive, Miami, FL 33157 (phone: 305-253-8100).

Data Mart, Inc. will publish the *OPPS Directory of Online Personnel, Products and Services,* to be updated twice a year. Registration for the first edition is open until June 30, 1985.

Data Mart, Inc., P.O. Box 13542, New Orleans, LA 70185-3542 (phone: 504-866-0828).

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MicroProse's Command Series of combat simulations puts you in charge of the great armies of the 20th century, in a variety of historical or "what if" scenarios.

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MicroProse Software, 120 Lakefront Drive, Hunt Valley, MD 21030 (phone: 301-667-1151).

Incorporating light pen technology, the Stack Light Rifle allows you to shoot-'em-up from as far as 10 feet away from the screen. Included are six disk-based games: *High Noon, Glorious 12th, Shooting Gallery, Rats 'n' Cats, Escape from Alcatraz,* and *Crow Shoot.* Romaro Enterprises, North American distributor of the rifle, will release additional games to retail for under $20.00 each.

Romaro Enterprises International, P.O. Box 227, Streetsville Postal Stn., Mississauga, Ontario, Canada L5M 2B8 (phone: 416-820-5235).

Between April 1 and August 31, Datasoft will mail a $5 rebate to purchasers of *Bruce Lee, Conan, The Dallas Quest, Pac Man, Dig Dug, Pole Position, Mr. DO!, Zaxxon,* or *Letter Wizard.* Rebate coupons can be found in appropriately marked packages, or with your dealer.

Datasoft, Inc., 19808 Nordhoff Place, Chatsworth, CA 91311 (phone: 818-701-5161).

Electronic Arts will award three $1000 prizes to those registered owners of their *Adventure Construction Set* who produce the best games in the Fantasy/Medieval, Spy/Mystery, and Science Fiction categories. Copies of winning games and all other entries will be made available to registered ACS owners for the cost of disk duplication and handling. Entries must be submitted (on disk) by January 1, 1986.

Electronic Arts, 2755 Campus Drive, San Mateo, CA 94404 (phone: 415-571-7171).

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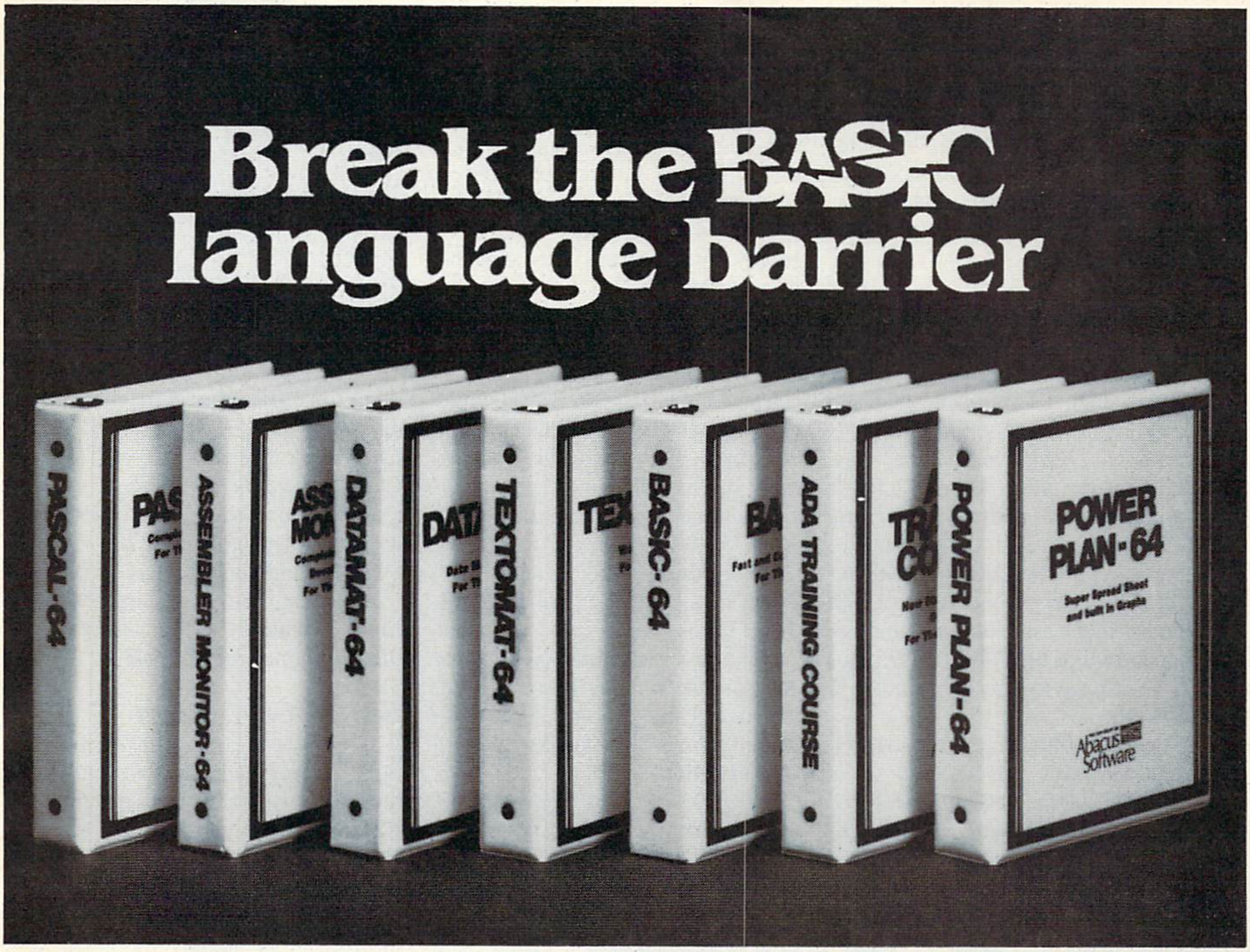
The *Pagewriter 64* word processor features an 80-column scrolling text window, onscreen command menus, and mailmerge option. A column indicator above the text lines provides a visual indication of the position of the text being entered. Available on disk ($21.95) or cassette ($18.95).

VMC Software, P.O. Box 326, Cambria Heights, NY 11411.

COMMODORE USER SUPPORT

Good news for Commodore user groups: the formation of Commodore World, a program designed to provide a direct link between Commodore and user groups around the world. Organizations approved for membership receive suggestions for organization, advertising support, and pre-release product news through the program's *Input/Output* newsletter.

Groups wishing to join should contact the User Group Coordinator at Commodore (215-431-9100); they will receive an application, sample bylaws, color advertising posters, and the first issue of the newsletter. Approved groups will receive an access code to the Commodore World section of Commodore's telecommunications network, additional posters,



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bulk shipments of the monthly newsletter, product brochures, and—far-fetched as it sounds—a "reliable" telephone contact at Commodore.

Commodore Business Machines, Inc., 1200 Wilson Drive, West Chester, PA 19380.

EDUCATIONAL PROGRAMS

The *Keyboard Chord/Scale Master* sharpens the user's keyboard abilities through a variety of sight and sound reinforcements. *Chord Display* and *Scale Display* let the user view and hear the most common chords and scales. *Chord Review* and *Scale Review* include drill, quiz, and compete options. The *Compare* mode requires comparison of one chord with another in the same or a different key signature. For the C-64; $39.95 plus $1.50 postage (MI residents add 4% sales tax).

Valhala Software, 205 E. Hazelhurst, Ferndale, MI 48220.

Kidbit Software has enhanced two previous VIC releases and combined them on one disk for the 64. The *Same/Not Same Game* lets children build a spaceship by telling the Central Computer which shapes, colors, directions, or letters are different from the others in the group. *Alpha-Bee Sequence* requires children to supply missing letters of the alphabet to a forgetful bee. $26.95.

Kidbit Software, 7001 Sunkist Drive, Oakland, CA 94605 (phone: 415-638-1243).

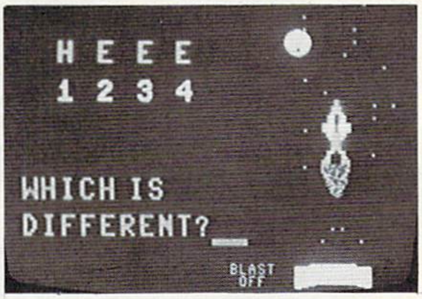
The *Chipwits* are 16 robots which children must help through 49 different mazes. They do this by programming the robots to move, feel, see, smell, remember, and more. For the C-64; $29.00-$39.00.

Epyx, Inc., 1043 Kiel Court, Sunnyvale, CA 94089 (phone: 408-745-0700).

Wurble incorporates vocabulary and spelling training into a computer board game for ages 10 up. The game editor allows for hundreds of rule variations.

Sher-Tek, P.O. Box 6808, Stn. "J", Ottawa, Ontario, Canada K2A 3Z4.

An elementary through high school



Same/Not Same Game: ***for ages 3 to 7.***
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teacher's guide, *The Investor's Challenge* is designed for use with Blue Chip Software's *Millionaire* stock market simulation, *Tycoon* commodity market simulation, and *Baron* real estate simulation. Price is $6.95.

Blue Chip Software, Inc., 6744 Eton Avenue, Canoga Park, CA 91303 (phone: 818-346-0730).

SOUNDCHASER 64

Passport MusicSoftware's $199.00 Soundchaser 64 is the first four-octave music keyboard for use with the 64. Included is software that transforms the 49-note music system into a full nine octave range, as well as allowing the user to create a variety of instrument sounds for either a monophonic or polyphonic keyboard. The keyboard can be used with Passport's *Macmusic* ($49.95), which provides a visually oriented music composition system.

Passport also distributes a line of *Computer Sheet Music,* allowing a student to play at his own pace while the onscreen notes he plays correctly change in color.

Passport Designs, Inc., 625 Miramontes Street, Suite 103, Half Moon Bay, CA 94019 (phone: 415-726-0280).

MASTERDISK CHANGE

In February's *Scuttlebutt* we announced *Masterdisk*, which composes a master catalog of your disk library. Since then, Integrated-Software has discovered that the 4-minute backup program included on the disk was pirated from a copyrighted German program. Taking its place will be *Copy 18,* which will copy track 18 (the disk directory) from any disk and make modifications.

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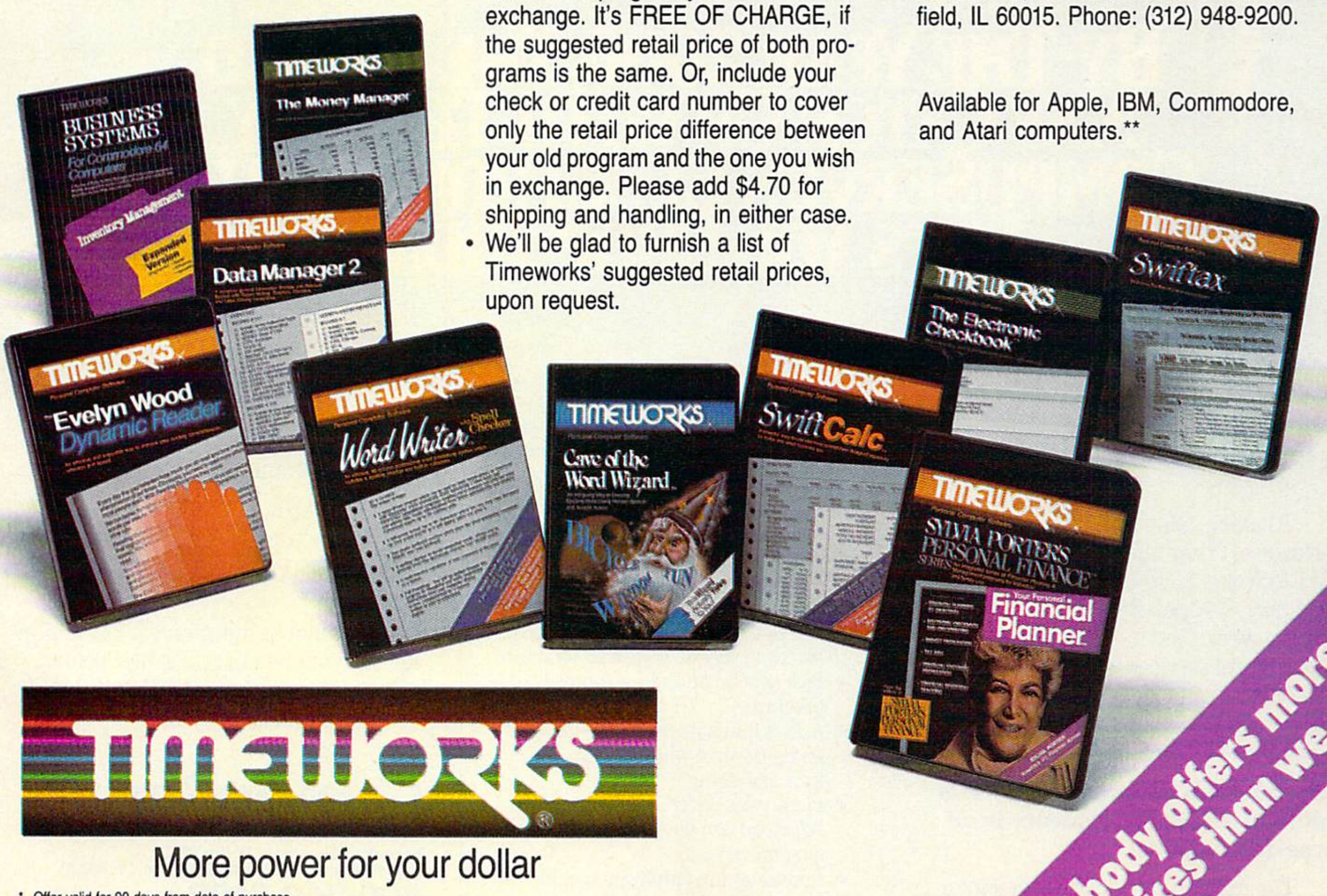
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Integrated-Software Systems, P.O. Box 1801, Ames, IA 50010 (phone: 515-233-2992).

VCR TITLE GENERATOR

The *Video Title Editor* lets C-64 or VIC 20 users incorporate title screens into their video tapes without the need for a camera, second VCR, or high-priced character generator. Included are over 20 displays for birthdays, weddings, vacations, and more. Customized displays can also be designed. Price is $29.95, on either cassette or disk.

Videoware, 19777 W. 12 Mile Rd., Suite 180, Southfield, MI 48076 (phone: 313-626-7208).

HANDICAPPING PROGRAM

The *Racing Analysis Program Package* includes *Thoroughbred, Harness,* and *Bet Return* programs which make predictions based on past performance data. About five minutes are required to enter the data for each race. For the 64 or VIC 20, on cassette or disk; $29.95 plus $2.00 postage from Software Exchange, P.O. Box 5382, W. Bloomfield, MI 48033 (phone: 313-626-7208).

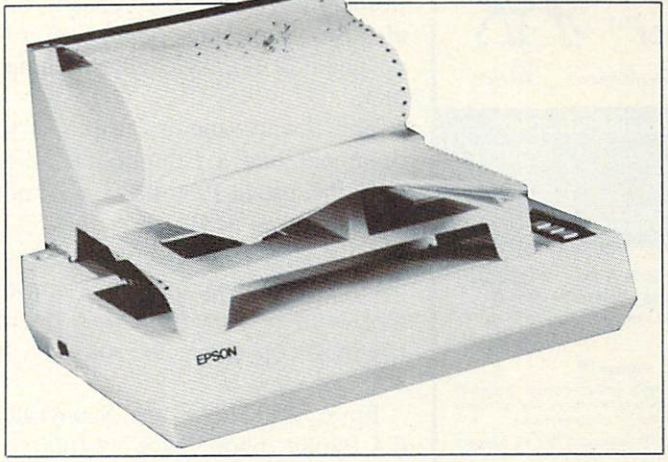
WILL WRITING SOFTWARE

By simply recording your answers to a series of questions, the *Willwriter* disk/software package generates and prints a will (good in every state except Louisiana) and provides you with information on signing and witnessing. You may update your will an unlimited number of times. For the C-64; $39.95.

Nolo Press, 950 Parker St., Berkeley, CA 94710.

ASTRONOMY SOFTWARE

For readers who thought Commodore's *Sky Travel* went where no program had gone before, a list of 45 astronomical software programs has been published by the non-profit Astronomical Society of the Pacific. A list of reference books is also included. Send a $1.00 donation to cover postage and handling to A.S.P. Computer List, 1290 24th Ave., San Francisco, CA 94122 (phone: 415-661-8660).



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Buddy Products, 1350 South Leavitt St., Chicago, IL 60608 (phone: 312-733-6400).

FAST LOAD LOWDOWN

From the research lab of *Ahoy!* writer Cheryl Peterson comes the following addendum to last month's examination of Fast Load from Epyx: Commodore computers interfaced to a printer through certain parallel boxes will not be able to use the program's quick copy function. A technical support person at Epyx explained that Fast Load requires all the data lines, rendering it unoperation-

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al with certain interfaces. Two of the primary offenders, unfortunately, are also two of the most popular: Cardco and the (Orange Micro) Grappler.

The documentation also fails to point out that a Commodore 1541 must be used; Fast Load will not work with an MSD, Indus GT, etc. Finally, don't misunderstand Epyx' claim that the program will work with most copy-protected software. It will run most copy-protected software. It will not copy it.

Epyx, 1043 Kiel Court, Sunnyvale, CA 94089 (phone: 418-745-0700).

BOOK RELEASES

The *Computerfacts* series from Howard W. Sams & Co., Inc., reveals the inner workings of Commodore hardware with wiring diagrams, photos, disassembly instructions, parts lists, troubleshooting techniques, and other repair data. Available for the C-64, C-16, Plus/4, VIC 20, 1525 printer, 1701 monitor, or 1541 disk drive; $19.95 each.

Also newly released, the *Commodore 64 Troubleshooting and Repair Guide* covers proper diagnostic techniques and lists specific malfunctions in trouble charts organized by computer subsystem. List price is $18.95.

Finally from Sams, *Commodore 64 for Kids from 8 to 80* works hands-on with the new user to create simple programs. Numerous illustrations are included. Price is $12.95.



Computerfacts *series: diagnostic aid.*
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A catalog of 347 book titles is available from Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, IN 46268 (phone: 1-800-428-SAMS or 317-298-5400).

Four new C-64 publications from Prentice-Hall:

Easy Interfacing Projects for the Commodore 64 ($10.95) provides dozens, ranging from mechanical actuators to analog-to-digital convertors.

Multiplan for the Commodore 64 ($14.95) offers a tutorial and over a dozen home and business applications (with listings).

With an emphasis on graphics generation, *Advanced Machine Code Programming for the Commodore 64* ($12.95) explains how to tap into the 64's 6502/6501 microprocessor.

More BASIC Is Child's Play, Commodore edition ($19.95) picks up where its precursor left off, teaching children as young as 7 to program. Prentice-Hall, Englewood Cliffs, NJ 07632 (phone: 201-592-2640).

Einstein's Beginner's Guide to the Commodore 64 ($7.95) provides a general introduction to computer use and programming. Harcourt Brace Jovanovich, 1250 Sixth Ave., San Diego, CA 92101 (phone: 619-231-6616).

Understanding Microprocessors ($14.95) covers software, programming concepts, assembly language, and applications of 4-, 8-, and 16-bit microcomputers. Texas Instruments Inc., P.O. Box 225474, M/S 8218, Dallas, TX 75265 (phone: 214-997-3926).

IT WRITES THE SONGS

Cantus, the Music Improviser purports to be the first microcomputer program that invents its own music. Instead of notes, the user enters choices for tempo, harmony, rhythm, counterpoint, voice range, and tone color, from which *Cantus* creates three-voice improvisations which play continuously with no repetition. Each set of choices becomes a "patch" which can be saved and later recalled. Price is $54.00 plus $2.00 postage and handling.

Algo-Rhythm Software, 176 Mineola Blvd., Mineola, NY 11501 (phone: 800-645-4441 or 516-294-7590).

TOWERS OF HANOI

FOR THE C-64

At the time of creation, the god Brahma placed sixty-four rings, ranging from smallest to largest, on the first of three golden towers in the temple of Benares. He enjoined his priests with the task of moving the rings, being careful never to place a larger ring atop a smaller, until the rings were placed in like manner on another tower. When this has been accomplished, in about six hundred billion years, the universe will come to an end. Such, at least, is the legend.

Actually, Edouard Lucas, who invented the Tower of Brahma puzzle, devised this story to popularize his creation. The puzzle has been a favorite for several generations. Now you can try your skill on a less formidable (though equally challenging) version using your Commodore 64. You may select to attempt from two to eight rings. Each additional ring represents a doubling in difficulty. To move two rings requires three moves; three rings, seven moves; four rings, fifteen moves; eight rings, two hundred fifty-five moves. The number of moves is determined by the formula 2 ↑ (number of rings)–1. Assuming the priests of Brahma moved one ring each second, it would require (2 ↑ 64)=1 seconds, or about six billion centuries, before the smallest ring would be placed on top of the tower.

With up to four rings, the puzzle is fairly easy to solve. After that, though, you must plan your moves carefully in order to complete it in the minimum number of moves. To end the puzzle, press 'fl'. Also, if you become completely baffled, again press 'fl' and you will be asked 'Computer Solution (Y/N)?". Answer 'Y' and the puzzle will reset and solve itself. The rings will begin to magically float across the screen and position themselves from one tower to the next until the final orientation is achieved.

The three towers and their base are built from keyboard character graphics in lines 2150-2240. Each ring is a sprite defined within lines 1990-2050. The DATA lines for each sprite show a way of conserving memory. The interpreter automatically READs a value of zero if a value is not entered. Another handy (though seldom used) command in the program is FRE(0). Normally, this function is used to calculate the amount of free RAM available for a program and its variables. In a program which creates and manipulates strings such as *Towers,* it performs a more valuable service. String values created during the course of a program run are stored in upper memory one beneath another until space is depleted. At this point, the process of garbage collection begins and may take several minutes, during which time the program stops and the keyboard is dead. Using a statement such as CT=FRE(0) forces an immediate garbage collection. Since this is done on each move, the number of strings that have accumulated is small and the process is instantaneous. □

SEE PROGRAM LISTING ON PAGE 111

BY DANIEL MILLER

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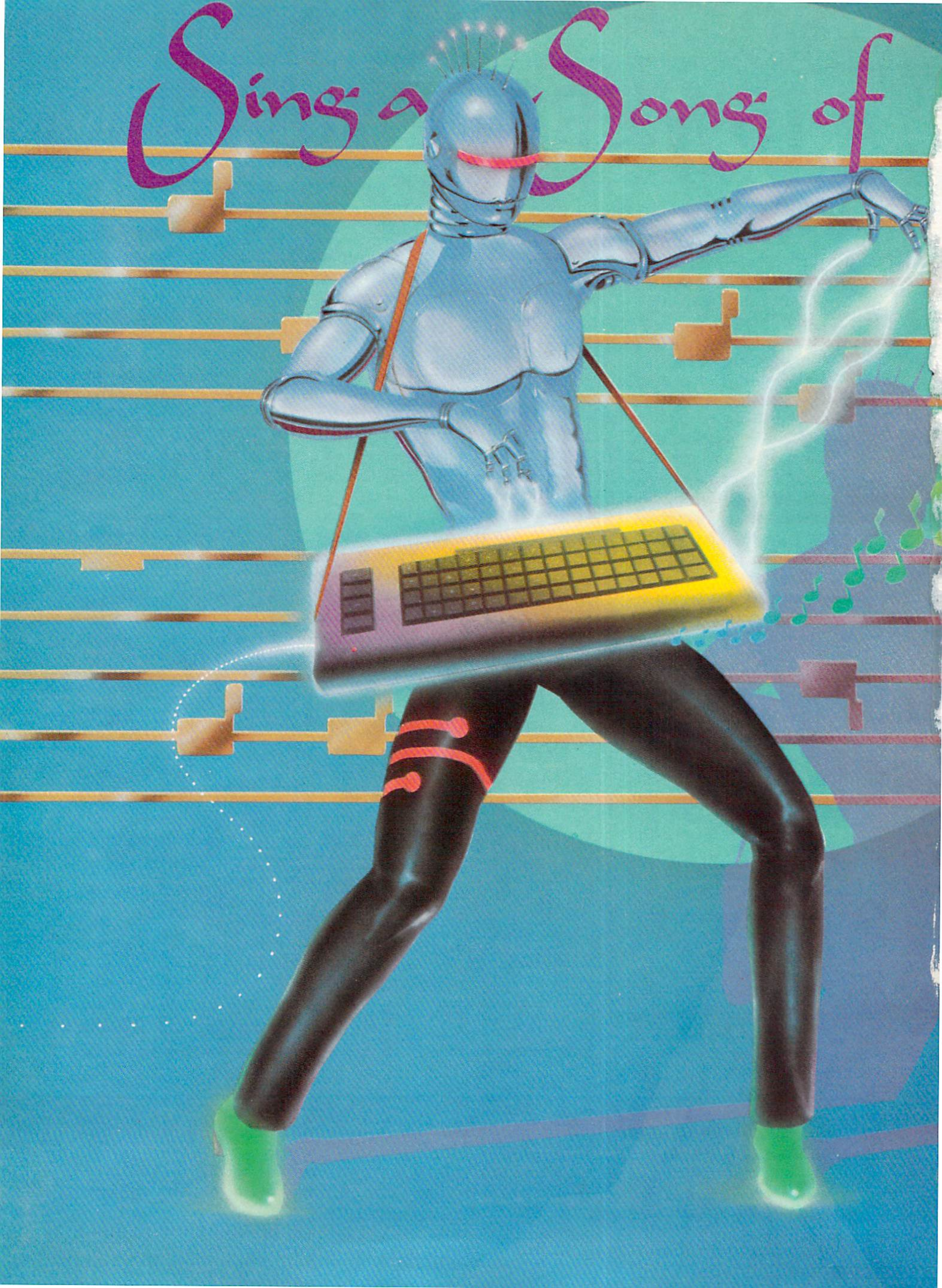
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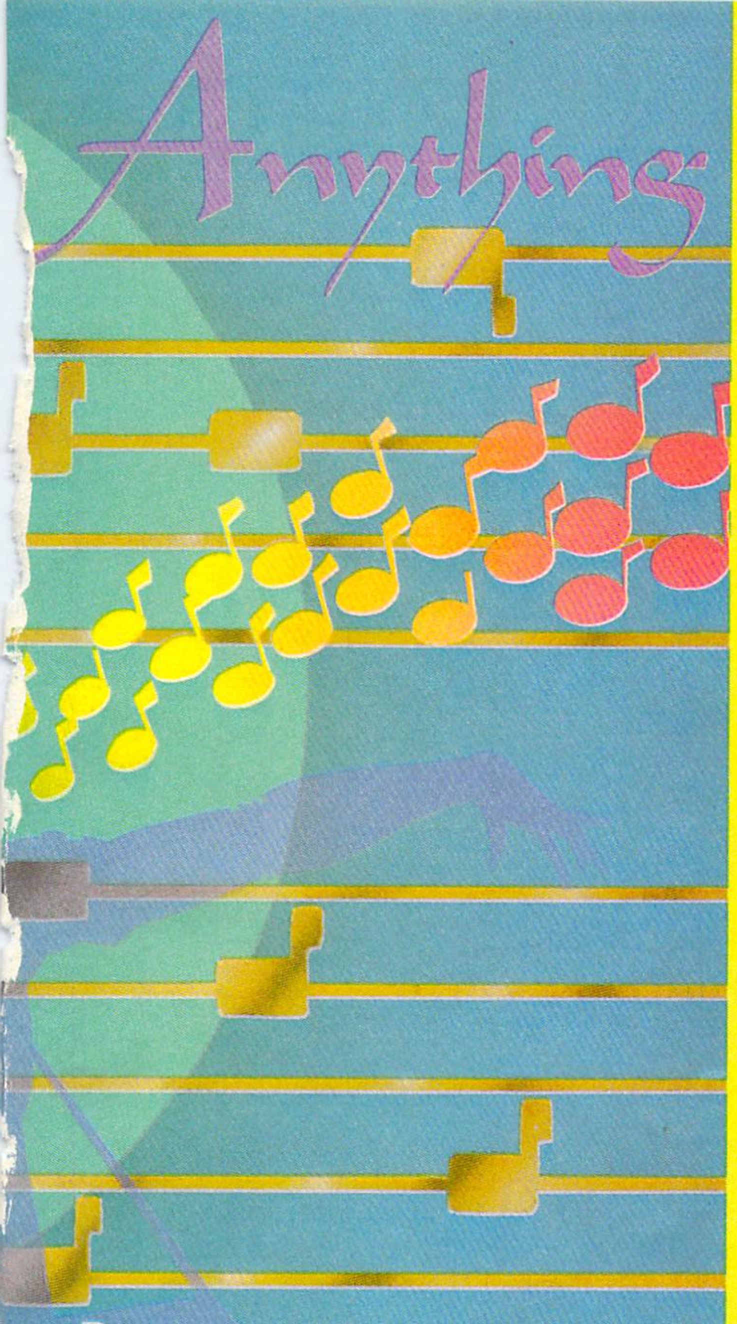
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CREATING YOUR OWN GAMES ON THE VIC AND 64

When the Commodore 64 first came out, one of its most touted features was the music capability. I had programmed on the Atari, and naturally I was a little skeptical about the 64's three voices—didn't the Atari have *four*?

Then I heard what the 64 could do with sound envelopes and waveforms, and I was willing to forgive the missing voice for the great improvement in quality.

Trouble was, all that wonderful sound was locked away from the BASIC user in a series of POKEs. They didn't give Commodore BASIC a SOUND statement comparable to the Atari's, which set the pitch, the distortion, and the volume in a single fast statement.

Instead, you have to set up the sound envelope and general volume in advance, and then *each time* you want to change the pitch or sound a new note, you have to:

1. Set *two* frequency registers *for each voice.*
2. Gate each voice open to begin its tone.
3. Gate each voice closed to stop.

Since every single one of these steps is a POKE, a notoriously slow command in Commodore BASIC, starting and stopping a single three-note chord takes *twelve* POKEs and far, far too much time.

About a year ago, I got a PCjr and, despite that machine's many drawbacks, I saw for the first time what a humane music program system could be.

Don't misunderstand—the Commodore 64 still has far and away the best sound chip on the market. The SID hasn't been matched by anybody.

But the PCjr has a mini-language for playing music. All you do is set up a string that contains the letters for the musical scale—C, D, E, F, G, A, and B—along with instructions about sharps and flats, octave changes, and the duration of the note, and BASIC plays the string. It even does it in the background, so that your program can go on long before the music's over.

All this seemed to me to be one more proof of the terrible conspiracy of the computer manufacturers. Take it from me, they all get together once a year and have a meeting like this:

COMMODORE: Look, we've got the best sound chip on the market in our new computer. You guys can't compete with it.

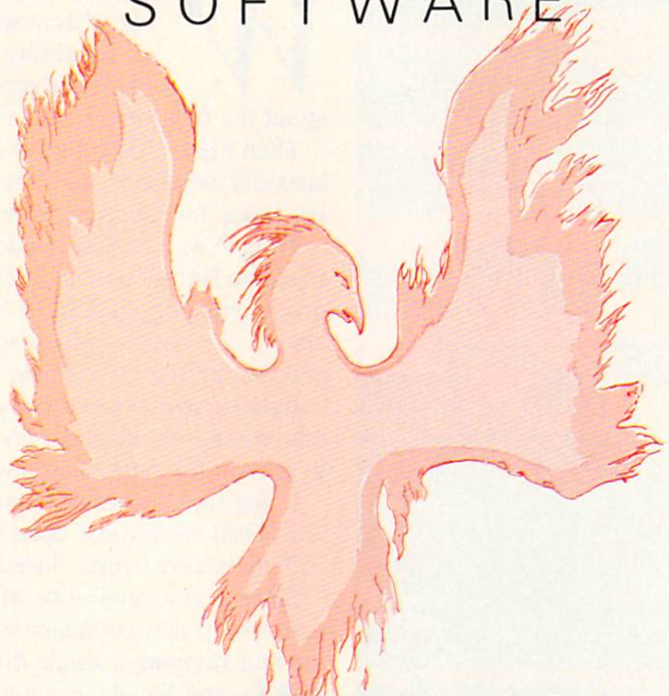
ATARI: That's OK—as long as you make your screen display all fuzzy and leave us as the only computer with a decent TV display, we'll let you have better sound.

IBM: You can have sound, Commodore, and you can have video, Atari. What we'll do is put superb sound and graphics commands into our BASIC. Real easy-to-program stuff. Atari, you can have a SOUND statement, but don't make it too easy to use. And you, Commodore, you can't do *anything* for them. Just a bunch of POKEs.

James Regan

By Orson Scott Card

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THE ALL-PURPOSE MUSIC ROUTINE

Are you going to sit still for that kind of collusion? Am I? Not a chance.

Instead, in this month's column I bring you Card's All-Purpose Music Player. To use this routine, you save it and then load it in at the beginning of your programming session. It uses up line 10, lines 60-70, and lines 9000-9990. Then you write your program around it. Put your movement routine in lines 20-50, for instance, and your main loop at 100. Program, in other words, just like normal.

Whenever you want to play a tune—or part of a tune—have your program GOSUB 60, and a phrase of the tune will play.

STRINGING ALONG

Best of all, to enter the melody, you don't have to calculate all the frequency values for the notes you're using, or set up a bunch of DATA statements. Instead, you enter each phrase of the music as a string, using the standard musical alphabet—the scale C, D, E, F, G, A, and B.

This means that you can transfer a song more or less directly from sheet music or, if you're good at music, right out of your head. All you have to do is divide the melody into a series of usable chunks, called "phrases." Each phrase can be as long as 255 characters, but for sheer practicality you'll probably break the music up into much shorter phrases.

The note strings are set up starting at line 9500 in all three versions of the program included here (*Three-Voice Player, One-Voice Player,* and *Broken Melody*).

Line 9500 tells how many voices you're going to use, minus 1. That means that for three voices, you type EV%=2; for two voices, you type EV%=1. (*One-Voice Player* has no line 9500, since only one voice is possible with this version of the routine. This allows it to be streamlined, and the music can play much faster.)

In line 9510, the variable ES% is set to the number of phrases in the song, minus 1. That means that if your song has 9 phrases, you will type ES%=8.

Starting at line 9520, the actual music strings are set up. There are three string types for each phrase:

Duration. MD$(PH) sets the duration for each note in the phrase. This is the same for all three voices—the three voices must each execute exactly the same number of notes (or rests) per phrase. The duration string consists of numerals from 0 to 9. 0 is the shortest duration, and 9 is the longest. By changing, say, the fifth number in the MD$(PH) string, you change how long the fifth note of that phrase will sound.

(These duration numbers are used as an index into a duration array, DU%( ), which is set up at lines 9200 and 9210. If you want to change how long a duration 1 lasts, just change the second number in the DATA statement in line 9210.)

Melody. ME$(PH,VC) sets the pitch or frequency for each note in the phrase, with a separate string for each of the three voices. The notation is very simple. To play the note A, type A. To play the note B, type B, and so on.

To play sharps, type the letter while holding down SHIFT. For instance, to play F-sharp, hold down SHIFT and then type F. A graphics character will appear in the string.

To play flats, type the letter while holding down the COMMODORE logo key. To play B-flat, hold down COMMODORE and then type B. Again, a graphics character will appear in the string.

To make the voice silent for one note, type the @ sign.

Octave. MV$(PH,VC) sets the octave in which the note will be played. There are eight possible octaves, from 0 (the lowest notes) to 7 (the highest notes). Each position in the MV$(PH,VC) string corresponds to that voice's note in the melody string.

In other words, the octave string MV$( ) determines which octave a note will be in, and the melody string ME$( ) tells which note within that octave will be played.

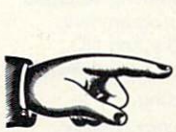
If several notes in a row are in the same octave, you only have to enter the octave number for the first note, and then enter spaces for the subsequent notes. Thereafter, for that voice, you need only enter octave numbers when the octave changes.

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Each octave consists of the notes from C up to the next B. That means that if your melody string consisted of an F-major scale, played in voice 0, and you wanted the scale to play very quickly, your strings would be typed like this:

Duration: MD$(PH)="00000000"
Melody: ME$(PH,0)="FGABCDEF"
Octave: MV$(PH,0)="4 5 "

Notice that there are the same number of characters in each string in the same phrase. (The B would actually be a B-flat, and you would type COMMODORE-B.) The octave changes when the scale goes up from B-flat to C. In other words, C is the lowest note of each octave.

(You can cheat, however, and type C-flat, which gets you a B in the next octave down without changing octaves. Likewise, you can type B-sharp and get the C from the next octave up. But why bother?)

PLAYING AROUND

This is really all you need to know to use this routine. All three programs use the same fundamental routine, with only a few changes, so once you've typed in one, it will be relatively easy to make the changes for the other programs (*One-Voice Player* has the most differences). To use the routine, all you need to do is type in your own songs—setting the values of EV%, ES%, and the duration, melody, and octave strings for every phrase and voice. Then whenever your program executes GOSUB 60, the routine will play the next musical phrase.

There are other changes you can make, however. Lines 62 and 68 can be altered by REMing one and executing the other, to switch from normal to staccato; or you can REM them both and get a legato sound (or nothing at all, depending on your ADSR envelope).

You can also experiment with different duration values at 9210. One limitation, though, is that you can't get any faster than 0. Since this is a BASIC program, not machine language, and we're still using those POKEs, there's a limit to how fast you can go. The ideal music system uses machine language routines during the vertical blank interrupt—but this is a teaching column, not a software column, and so we'll stick with BASIC.

You can also change the elements of the ADSR enveloped by altering lines 9020, 9030, 9040, and 9050; and you can change the waveforms in line 9070. Next month I'll get into much more detail about how waveforms and envelopes are used, and we'll experiment with some sound effects; for now, though, you can make your own experiments by changing one or two parameters at a time.

The three programs show some of the things you can do. *Three-Voice Player* plays *God Save the King (My Country, Tis of Thee)* using a stately organ tone. *One-Voice Player* plays The Mexican Hat Dance at top speed, with a harpsichordlike hammered-string sound. *Broken Melody* plays *I'm on My Way* (from the musical *Paint Your Wagon* by Alan Jay Lerner and Frederick Loewe), using a fife sound for the melody line and a plucked-violin sound for the accompaniment.

Have Patience. When using the three programs, remember that in order to make the running time for the music very quick, most of the work is done during the execution of the setup routine at 9000. Especially time-consuming is the conversion of the strings from musical notes to values that music routine can use efficiently. A song as long and complex as the one in *Broken Melody* takes a couple of minutes to be ready. If we were working in machine language, this wouldn't be necessary, but the long setup time is the price we pay for being able to enter the music as musical notes and still have it play relatively quickly.

HOW SHOULD YOUR GAME USE MUSIC?

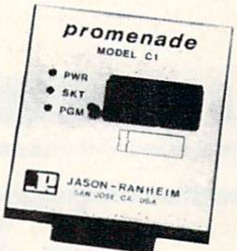
Obviously, this routine can't be used for background music, though that's one of the best uses for music in a game. If you've ever sung along with a video game (*Xevious, Gyruss,* and *Elevator Action* are particularly musical, I've noticed), you know that background music can set the tempo and mood, getting more intense as the player gets further along in the game.

But even when the music has to take place in the foreground, stopping everything else, the phrases of a song can be very useful. For instance, in a quiz game, instead

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One of the fonts we like best is "Proportional" because it looks most like typesetting. The spacing for thin characters like "i" and "l" are given less space which "tightens" the word making reading easier and faster. This is only one example of the careful planning put into the GP-550.

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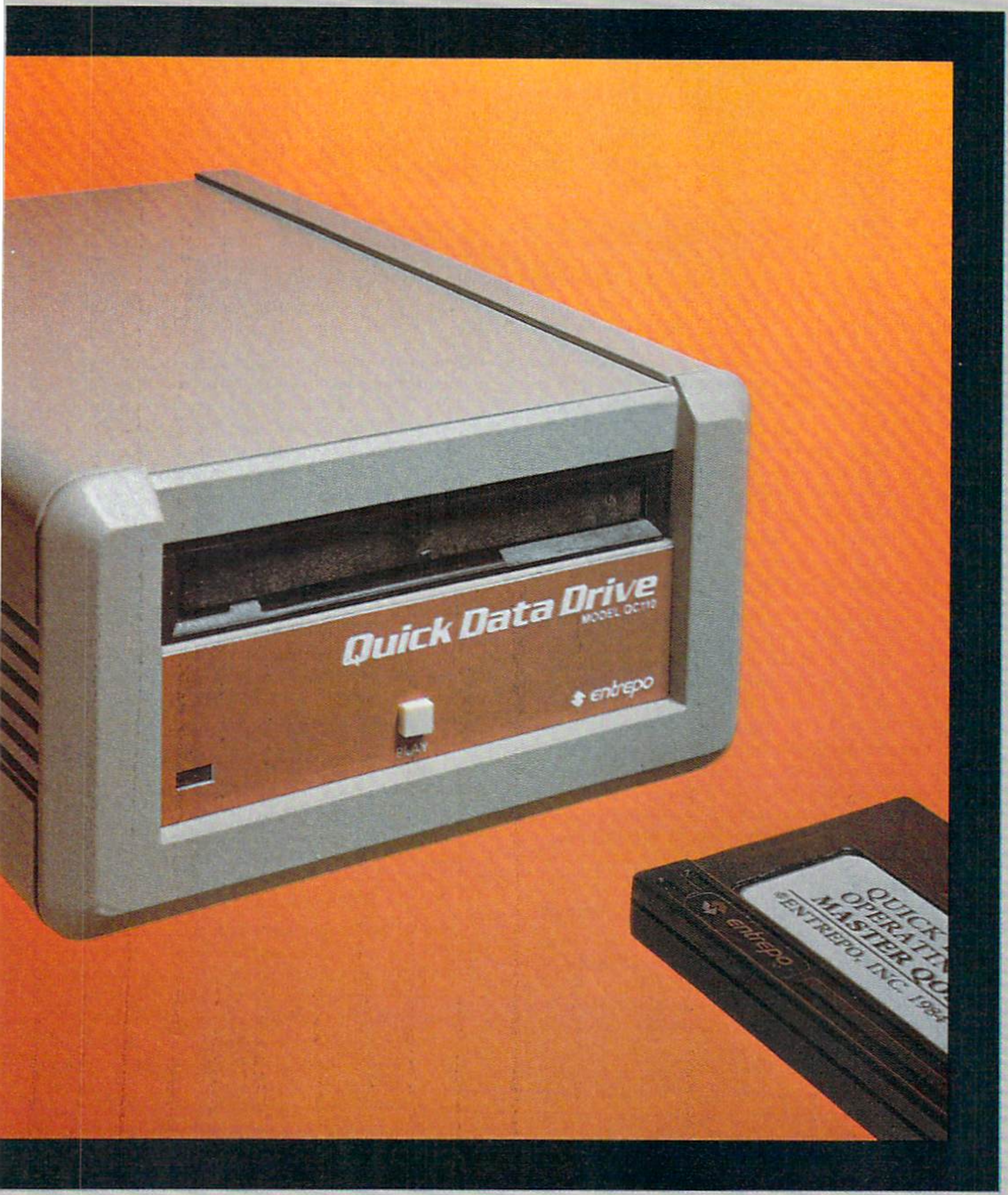
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of the incessant "beep" for wrong and "ding-dong" for right answers, you can play one phrase of a song as the question is asked, and then play the next phrase when the player gets the right answer. But for a wrong answer, the song is left dangling—which will certainly increase the player's desire to get the answer right and finish the stupid melody!

Songs are also useful while players are reading instructions, checking scores, consulting maps, and so on.

And there's no rule that says the phrases have to be pieces from the same song. You can have a dozen different songs, and play different ones at different times. Just set the value of PH to the number of the phrase you want to play, and then GOSUB 60—the phrase you called for will be the one that plays. (If you don't specify a value for PH, the next phrase in numerical order will always play next.)

Broken Melody is designed to show how a tune can be broken up into pieces, with the different phrases played only if and when the player gives certain input. The other two programs play continuously until the player presses SHIFT. *Broken Melody*, however, waits for the player to press SHIFT before playing anything, and stops to wait for another keypress between phrases. Pressing any key besides SHIFT, COMMODORE, and CONTROL will end the program.

If you hold down a key during a song, you'll notice that the song slows down. This is because the timing for the music is done with FOR-NEXT loops, and when you press a key it causes an interrupt that uses up processor time; this cuts down the number of repetitions of the FOR-NEXT loop per second, which makes the notes last longer and slows down the song.

DECIPHERING THE ROUTINE

For your ease in understanding how the program works, here is a list of the variables and what they are used for:

ME$*(phrase, voice)* or ME$*(phrase)*: After the conversion routine at 9900, this variable contains both the pitch and octave code numbers in ASCII form, for use as an index into the pitch value tables in PI%( ).

MV$*(phrase, voice)* or MV$*(phrase)*: Used only during the conversion routine at 9900; its information is contained thereafter in ME$.

MD$*(phrase)*: Contains the duration values; the VAL( ) function retrieves the values for use as an index into the duration table DU%( ).

ES%: The number of phrases in the song, minus 1.

EV%: The number of voices in the song, minus 1.

PI%*(code,*0) and PI%*(code,*1): The pitch table, consisting of the low byte and high byte, respectively, for the frequencies corresponding to the musical scale. The code is derived from the ME$ string using the MID$( ) and ASC( ) functions. The PI%( ) values are POKEd into the frequency registers.

FR*(voice,*0) and FR*(voice,*1): The address of the two frequency registers for each voice. Voice 0, for instance, is at 54272 and 54273, so those are the values of FR(0,0) and FR(0,1).

G%*(voice)*: The gate value. POKEing this into the gate register causes that voice to begin to sound. The gate value also determines the waveform (see line 9070).

UG%*(voice)*: The ungate value. POKEing this into the gate register causes the sound of that voice to stop.

GR*(voice)*: The address of the gate register for each voice.

DU%*(code)*: The duration table. Each of the ten possible durations (0-9) consist of the number of times the empty loop at line 67 should be repeated. The code is derived from the MD$ string using the MID$( ) and VAL( ) functions.

VC: The current voice number. This is used whenever the program cycles through the voices; it is the counter variable in a FOR VC=0 TO 1 loop.

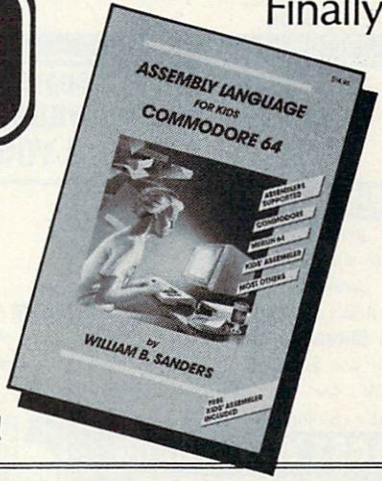
PH: The current phrase number. This is automatically incremented (increased by 1) each time the routine is executed, but your program can set this variable independently and take the phrases in any order.

N: The current note number. This is the counter variable in the loop FOR N=1 TO LEN(MD$(PH)) at line 60; it is used with the MID$( ) function as the index into the ME$ and DU$ strings.

AT%, DY%, SN%, RE%, WF%: These variables are used in setting up the envelopes and waveforms; they are

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not used after the music is initialized at 9000, so they can be used again in your own program.

X%, Y%, V$, A$, I: These variables are used as placeholders and counters at various times during the program. They are never used after the music is initialized at 9000, so they can be used again in your own program.

Line by line, here's what's happening in the sound routine at 60-70.

60 Begin a loop through every character in the duration and melody strings.
61 Begin a loop through each of the three voices.
62 Un-gate the sounds left over from the last note. (REM this line if you're using the line at 68.)
63 Begin a loop through the two frequency registers for each voice.
64 POKE the pitch values–PI%( )–into the frequency registers–FR( ). (Remember that a rest ("@") in the original tune produces the PI% value of 0 in both registers, which makes the voice silent for the duration of the note.)
65 Close the VC and I loops. (The N loop is still open.)
66 Open a new VC loop, only this time backward, to gate the voices open. This causes the new pitches to play. Close the loop.
67 Execute the duration loop.
68 Open a new VC loop to gate off the sound. This line is REMed; remove the REM and cause the line to be executed if you want clearly separated, staccato sounds.

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69 Close the N loop. When the loop runs out, add 1 to PH so the next time through the loop, the next phrase will play–unless the main program has changed the value of PH in the meantime. (Note that if PH is higher than ES%, the total number of phrases, it is set back to 0.)
70 Gate off all the voices. This only executes after the phrase is over. Then RETURN from this subroutine to the main program.

Next month, in addition to examining sound envelopes on the 64 and emulating them with a machine language routine on the VIC, I'll provide a machine language music routine for each computer.

DISCOVERING AMERICA

Even though this isn't a review column, every now and then I find a commercial game that is so good I have to tell somebody–and you are the somebody I tell.

Seven Cities of Gold (distributed by Electronic Arts; created by Ozark Software, underpriced whatever it costs) manages to do what I thought was impossible: it has all the story excitement of a text adventure, yet it's entirely controlled by a joystick and it all happens graphically on the screen.

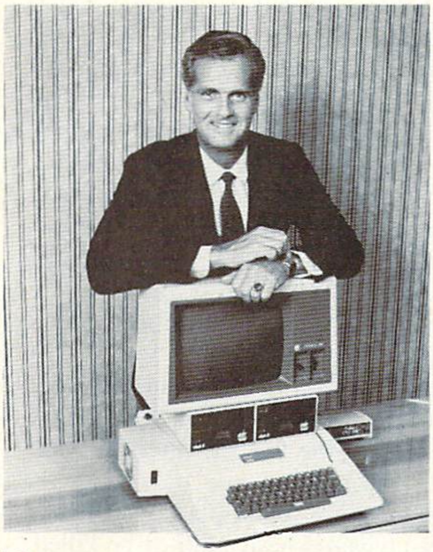
You are an explorer, sent forth by the King of Spain to reach the Indies. Like Columbus, you have a happy accident–you find a New World waiting to be discovered, explored, exploited, and converted.

The authors have done a remarkable job of giving us the experience of discovery. There is no map, at first–but as you sail along the coast or lead a band of men into the wilderness, a map is automatically drawn. You ordinarily see only the small area surrounding you; press the button, and you can see a considerably larger portion of the map. Only when you're safely home in Spain, however, can you see the entire map of all your discoveries. (You can also cheat by pressing D when you're back home; even the undiscovered lands are displayed then, but you get no more credit for discovering anything.)

In the New World, you discover major, medium, and minor rivers, and such exotica as "A land of high mountains" or "A land of lush jungles." Each new discovery adds to your reputation as an explorer–it is counted into your score.

But you don't run these expeditions out of love of discovery alone. They're expensive, and you have to make the investor's money back, particularly since the investor is the King of Spain. So you have to get gold. The simplest way is to discover a gold mine and ransack it–but there aren't many signposts saying "This way to the free gold."

Instead, you have to deal with the natives. And here is where *Seven Cities of Gold* stands head and shoulders above any other adventure game I've played. Your expedition brings along a certain amount of trade goods. When you discover a city or a village, you can trade for food or whatever gold the natives have. However, it isn't just a matter of simple barter. The natives don't necessarily



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Your one great idea. I've got it.

Hello, my name is Larry Carter. Until recently I was the owner of just one business—Carter Spray Finishing Corporation. I built my company up through the years but expansion didn't come easy. There were always problems, long hours of hard work, weekends at the office.

The only good thing was the payoff. I lived in a plush apartment, drove a Cadillac Eldorado, wore expensive clothes. Still, my life was wrapped up in my business. I had a gorgeous beachhouse but hardly ever went there. Liked to go skeet shooting but rarely picked up my hand-crafted gun. I found it almost impossible to tear myself away from work.

Then, a short while ago, I invested in a computer to help me run my firm. Those 50-60 hour weeks were finally getting to me.

I became fascinated by my electronic marvel and went shopping for one for my home.

That was my introduction to the vast potential of the multi-billion dollar personal computer market. My business sense got aroused. Here was an opportunity too good to miss. I knew I had to grab it. The only question was "how?"

I was sitting at my new "toy" when the light bulb went off in my head. I was sure my idea was a winner ... couldn't wait to put it to work.

Start-up was simple as pie. And the results took me by surprise.

To a guy who always slaved for a buck, the money was almost sinful. It came in so fast and easy. And there were no backbreaking hours. No headaches.

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More money, less work.

Today I am in the spray finishing business and the personal computer business. I'm a greater success than ever. And I work less than ever, too. All because of the change that occurred when I came up with my great idea.

A few trusted employees manage my spray finishing concern when I'm not there. And my home-based personal computer business—why that's not work, it's part-time fun that's paying me a handsome full-time salary.

Life's a ball. I threw a few parties at the beachhouse last summer. Go skeet shooting every chance I get. And am looking forward to some exciting vacations.

Now I'd like to share my idea with you. Because the market's too big for just Larry Carter. Because I get a kick out of helping others. And because I believe more folks should work for themselves. For as I well know, when you're self-employed, you're happier, more independent and enjoy the full reward of your own effort.

With my idea, that reward can be substantial. You can make as much as three thousand five hundred dollars—$3,500—in your first two weeks of operation. With only 1½ hours of work a day. And that's only the beginning.

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All you need is ambition and the desire to succeed. For when you use my idea, you don't have to sell door-to-door. You don't have to bother friends or relatives.

You don't need lots of start-up capital. There's virtually no investment involved. You don't need to live near other personal computer owners. Don't need to be a programmer. My idea is based on applied business and common sense, not a knowledge of computers. There's nothing complicated about what I have to show you.

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In my new book, "The Profit Potential in Your Personal Computer. The $25,000-a-Month Idea," I'll tell you how to put my concept to work. Give you all the simple-to-understand instructions. Help you start making money the day you put my plan into action.

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Three FREE gifts and a money-back Guarantee.

To make your investment even more attractive, I'm also going to send you three FREE gifts: (1) a second thought-provoking book crammed with ideas (less profitable than mine but just as creative) on how to increase your income with a personal computer, (2) an audio cassette that accompanies my book, and (3) periodic updates on material that relates to my idea.

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like having strangers—particularly armed and dangerous ones—mucking about in their towns.

When you enter a village, your expedition is represented by a single figure, however many men you have with you. If you bump into one of the many figures representing natives, that native is killed. And since they come jostling around you pretty quickly, you have to scramble to keep from bumping them. Bump one or two, and maybe you can still trade with them—kill a third, and you've got a battle on your hands.

Fortunately, you have a few things in your favor. The first time you enter a village, you can choose to amaze the natives; this makes them stand back and let you through for a second or two. Then, when you get to the center of the village, where the chief is waiting for you, you can give him gifts. (You can also give gifts to the common folk, but it gets you little more than the time of day.) When you've given the chief enough gifts, he'll trade with you.

The chief is the key to winning battles, too. I hate to tell you the defect of character that led me to discover this, but if you begin a battle by treacherously killing the chief before attacking anyone else, you win a lot more easily, with less loss of life on both sides. This means that whether you want to trade or invade, you still are better off doing as Cortez and Pizarro did—make your way to the head man before you show your guns.

After you trade with or vanquish a village, many of the natives become bearers, allowing you to carry far more gold and food than your men could carry alone. These bearers usually stay with you until you board your ship and sail away.

Word spreads among the natives, too. If you've made friends with the natives, they'll tell you about other towns and you'll see the villages without having to stumble across them—a great time-saver. But if you've been wantonly killing, the next village will be warned and will attack you immediately.

Believe me—killing everything that moves is a sure way to achieve disaster.

When you conquer a village, you can usually establish a mission there; but the natives will be hostile, and will often overthrow the garrison you left behind. However, if you have been unusually kind in your dealings with a village, the chief will voluntarily ask you to establish a mission.

In other words, the way you behave, the moral character you establish in the game, affects the way the other characters in the game respond to you. If you're bloodthirsty or careless of your men, either the natives or starvation will finish you off; if you're careful and wise—and sometimes ruthless—you'll achieve high rank when you return to Spain. The best I've done at journeyman level is Viceroy—it's hard to imagine the King giving you any higher rank! But there's an advanced game that I haven't even tried to play.

An added benefit is the world-building program. If, like me, you are familiar enough with the history of the European conquest of America that you know all the places to go to conquer great empires, then you can use the world-building option to create new continents. The program was well-designed: the invented continents are realistically laid out. And this time, you really are exploring a world that *no one* has ever seen before.

In other words, this is that rare thing: a perfect game, which is worth the price you pay for it.

The graphics are beautiful, I love the world-building, the simplicity of acting out a very complex story is amazing—but what I like best is the fact that the game responds to you on a moral level.

This is way beyond anything you've played in the arcades. Most shoot-'em-up games have a kill-or-be-killed premise. When I first started playing text adventures, I tried talking to the dwarfs and other creatures in the underground caverns, but they were only interested in killing. A few text adventures—*The Lords of Karma,* the many Infocom games—have more variety, in that not everybody you meet wants you dead, but I have seen none that do what I've been asking for since I first wrote to the guys at Infocom back in 1980: I want the game to change to respond to the kind of person my player-figure reveals himself to be.

I imagined then a text adventure in which, if a player kills everything that moves, within a few turns all the creatures in the cave get together and wipe him out. That's civilization, isn't it? Ganging up on the killers?

More important, though, I wanted the adventure worlds to be peopled with characters who respond to you individually. If you show yourself to be greedy, the thieving types would gravitate to you; if you're considerate, people who need help will call on you and then help you in return; if you're generous, you'll be trusted—but you'll also be taken advantage of; if you're cowardly, you'll be bullied. Certain characters will become your friends and fellow travelers; others will be your enemies; still others will be indifferent.

Seven Cities of Gold is the first program I've seen that takes an important step in this direction. It gives game-playing, for the first time, the moral dimension that has previously been reserved to the storytelling arts like film and theatre and fiction.

I hope this game does so well that other game designers learn from it. ☐

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Ahoy!'s Bulletin Board System

If your computer is equipped with a modem, you can call *Ahoy!*'s Bulletin Board System (718-383-8909) any hour of the day, any day of the week to exchange electronic mail with other Commodore users or download files like the following:

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HOW MODEMS WORK

The subject of computer telecommunications completely baffles most novices. Anyone who has ever been a teenager knows how people use a telephone, but the way in which a computer communicates over the phone lines is much less obvious. After all, they don't have any arms, lips, ears, or dimes, and even if they did, what's a computer going to talk about? Complain about his disk drive, or gossip about that cute little VIC down the street? To make matters worse, telecomputing carries with it an imposing load of jargon. Just when you were beginning to understand the difference between ROM and RAM (or had given up trying), along come terms like modem, terminal, duplex mode, carrier, answer and originate modes, and parity bits. As Mr. Bill would say, "Oh Noooooooo."

Not to worry. As surely as a telecommunications system transforms electrical signals into information, this installment of *Ship to Shore* will cut through the mumbo-jumbo surrounding computer communications. We'll take a look at the equipment used in telecomputing, how it operates, and some of the terms associated with that operation.

Anyone who has used a computer knows that they communicate through input or output devices. We use input devices such as the keyboard, joystick, light pen, or game paddles when we want to send information to the computer. We use output devices such as the display screen or printer to take information from the computer. During telecommunications, the computer receives information from another computer just as it does from the keyboard, and it sends out information to another computer the same way it sends it out to the display screen. The only difference is that unlike most input/output devices, the other computer is not physically present in the same room as yours. Usually, you hook up your computer to external devices like a printer or disk drive by attaching the two with a cable. Since a telecommunications link is established over phone lines, some extra equipment is needed.

Figure 1 shows the basic elements of a telecommunications link. At either end of the link is a computer (labelled "c") connected to a phone line by a device called a modem (labelled "m", and pronounced "moe'dem"). Usually, a computer communicates to outside devices by means of electrical signals running through wires. But the phone lines which serve as the most common medium for communicating between two points are designed to carry sounds, not the tiny electrical impulses that a computer generates. That's where the modem comes in. It takes the electrical signals from your computer and turns them into sounds that can be sent over the phone lines (or MOdulates them), and takes the sounds that were sent over the phone lines from another computer/modem combination and turns them back into electrical signals (or DEModulates them). The net effect is the same as if the two computers were connected by wires, and exchanged electrical signals directly. The only difference is that sometimes if there is static on the phone line, the information may be garbled during the transmission.

Most Commodore users have modems that were made specifically for Commodore computers and plug right into the user port. But it is also possible to use general-purpose modems with the help of what is known as an RS-232 interface (the box connected to the remote computer in Figure 1, labelled "r"). The name RS-232 may sound mysterious, but actually, it stands for Recommended Standard 232. It just so happens that Standard number 232 of the Electrical Industry Association describes a standard interface to be used with telecommunications devices. Since computers use a lot of different kinds of signals internally, the electronics industry decided to define standard plug and socket connections, as well as standard electrical signal levels, so that the same telecommunications equipment will work with all different kinds of computer equipment. By buying an RS-232 interface (for about $40) that plugs into the User Port, you can make your Commodore computer send out electrical signals that are compatible with all kinds of non-Commodore modems, and other RS-232 devices as well (such as printers and speech synthesizers).

So far, we've shown what it takes to physically connect your computer (sometimes called a terminal, because it sits at the end of the line) and the remote computer (sometimes called the host, because it allows "guests" like yourself to operate its programs by remote control). But all the hardware hookup does is allow the two computers to exchange electrical signals. Before we can use this system to actually transfer information, we have to get the two computers to agree on what those signals mean. This is accomplished by the terminal software that controls the exchange.

Since computers only understand numbers, and not letters, the first task is to convert the text using a code that

By Sheldon Leemon



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- ☐ S404 Rolodex Petite. Carrier is 8" wide. Holds eight Rolodex Petite cards.
- ☐ S408 Rolodex 2¼ x 4. Carrier is 8" wide. Holds eight cards.
- ☐ S412 Rolodex 3 x 5. Carrier is 8" wide. Holds seven cards.
- ☐ S505 3½ x 5½ Index and Post Cards. Holds five cards. Carrier is 8" wide.
- ☐ S510 4x6 Index Cards. Holds four Index Cards. Carrier is 9½" wide.
- ☐ S515 3x5 Index Cards. Holds five Index Cards. Carrier is 8" wide.
- ☐ S520 5x8 Index Cards. Holds four Index Cards. Carrier is 10" wide.
- ☐ S707 Letterhead 8½ x 11. Holds three Letterheads. Carrier is 10" wide.
- ☐ S714 Memo size 5½ x 8½. Holds three Memo size sheets. Carrier is 8" wide.
- ☐ S721 Legal Letterhead 8½ x 14. Holds two Legal Letterheads. Carrier is 10" wide.
- ☐ S728 Ditto or Forms 8½ x 11½. Holds two. Carrier is 10" wide.
- ☐ S735 Forms 8½ x 11¾. Holds two. Carrier is 10" wide.
- ☐ S808 Voucher Checks, Quick Letters, Quick Reply, Invoices, Purchase Orders 8½ x 7⅝. Holds three 8½ x 7⅝ Forms. Carrier is 10" wide.
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the computer can understand. The most common code is called ASCII (American Standard Code for Information Interchange). In ASCII, the number 65 stands for the letter "A", 66 stands for the letter "B", 97 stands for "a", etc. Internally, your Commodore computer uses a variant of this code called PETASCII, in which 65 stands for "a", while 97 stands for "A", but your terminal program will make the conversions so that you communicate in the same standard ASCII everyone else uses.

Let's follow the process of how your computer converts text to numbers, step by step. First, the program starts with text characters that you type in. For our example, let's use the letters

V I C

The ASCII codes for these letters are:

86 73 67

These numbers are in the form of decimals, the base ten numbering system that humans use. But computers use base two, or binary numbers. They find these numbers easier to work with, because in base two, all numbers are expressed using only two digits, the "0" and the "1". Of course, it takes a lot more digits to write a number in binary. In fact, in order to write any number from 0 to 127 (as you must in order to use the 128 characters of the ASCII code), you need at least seven binary digits. The seven-digit binary equivalent of the ASCII numbers above is

1010110 1001001 1000011

As you will see later, not only are these kinds of numbers easy for the computer to work with, but they are also easy to convert into sounds.

Even though we have changed our text characters a lot so far, we're not through yet. For one thing, some telecommunications programs use an extra binary digit (or bit) for what is called parity. In the early days of telecommunications, noisy telephone lines were an obstacle to information exchange, because the noise on the line could be misinterpreted as a false signal. Some way of determining whether the data received was exactly the same as the data being sent was needed. By adding one more digit to each character, a crude form of error detection called "character parity" was implemented. The way it works is simple: if you choose EVEN parity, the extra digit is used to insure that the number of "1" digits is even, and if you choose ODD parity, the extra digit is used to insure that the number of "1" digits remains ODD. For example, using even parity, our binary representation of the letters VIC:

1010110 1001001 1000011

becomes

01010110 11001001 11000011

The receiving computer would use this parity bit as a safeguard against bad transmission. If the bits didn't add up, the computer would know that the transmission was faulty, and could ask for the character to be sent again. This kind of simple error checking really belongs more to the era of mechanical teleprinters than today's modern computers. Nowadays, very few systems use parity. When you select NO PARITY with your terminal software, the eighth bit is always changed to zero (unless you want to send special, non-ASCII characters), so that our binary code for VIC becomes

01010110 01001001 01000011

We're almost ready to ship out our data, but we still have one last manipulation to perform. We've got to add "framing" bits that show where each character begins and ends. In order to understand why, let's go over the way in which the modem translates electrical signals to sounds.

Modems use two sets of frequencies to send and receive data. These are technically known as "answer" and "originate" frequencies, but let's just call them "high" and "low" tones. One modem will send information using the high voice, and will listen for a reply which the other computer sends using the low voice. The other will use the opposite pair of tones. Two sets of tones are needed so that the modem can differentiate between tones which it is sending, and those received over the phone lines.

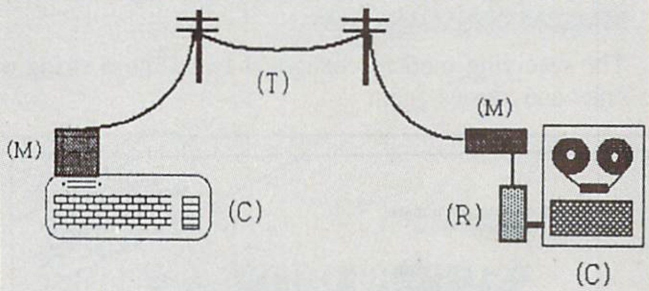


Figure 1: Telecommunications Link
M: modem T: telephone link
C : computer R: RS-232 interface

Each voice uses notes of two different frequencies, called MARK and SPACE. As you might guess from their names, MARK represents the "1" character, while SPACE represents the "0" character. By convention, the normal "quiet" state of a phone line when no data is being transmitted is a continuous MARK tone, which can be considered a constant stream of ones (this continuous tone is also called a "carrier," because the data string of ones and zeroes is superimposed upon it). To isolate our text character, which has now been converted to a stream of ones and zeroes, we "frame" it by putting a SPACE or zero character on either side of it. The zero character that comes before our text is called a start bit, while the one that comes at the end is known as a stop bit. Therefore, the binary numbers which stand for the letters VIC:

01010110 01001001 01000011

become

0010101100 0010010010 0010000110

Finally, we're ready to send this text. Here we have

a "quiet" communications line (all MARK tones, or ones, remember) just waiting for some data:

MMMMMMMMMMMMMMMMMMMMMMMMMM
MMM

When we type the letters "VIC", the ASCII codes for which are

86 73 67

our computer recognizes what we typed as

01010110 01001001 01000011

and our telecommunication software adds in the start and stop bits to change it to

0010101100 0010010010 0010000110

This data is sent to the modem, which changes the zeroes and ones into the high and low sounds known as MARK and SPACE tones:

SSMSMSMMSS SSMSSMSSMS SSMSSSSMMS

The modem superimposes these tones over the continuous MARK tone of the "quiet" line:

MMMSSMSMSMMSSMMMSSMSSMSSMSMMM
MMSSMSSSSMMSMMM

The receiving modem changes it back into a string of ones and zeroes again:

1110010101100111001001001011110010000110111

The telecommunications software on the computer at the receiving end must watch this stream of characters. Because of the agreed upon convention, it knows that the first zero it sees means "Hey! The next eight bits are a character, and ninth bit had better be a zero that marks the end of the character. After you get that last zero, you'll see some ones for a while, until you get another zero that starts another character." In this way, the extraneous ones added in by the continuous drone of the "carrier" tone are stripped away, and the computer at the other end receives the characters

0010101100 0010010010 0010000110

which it displays as the letters

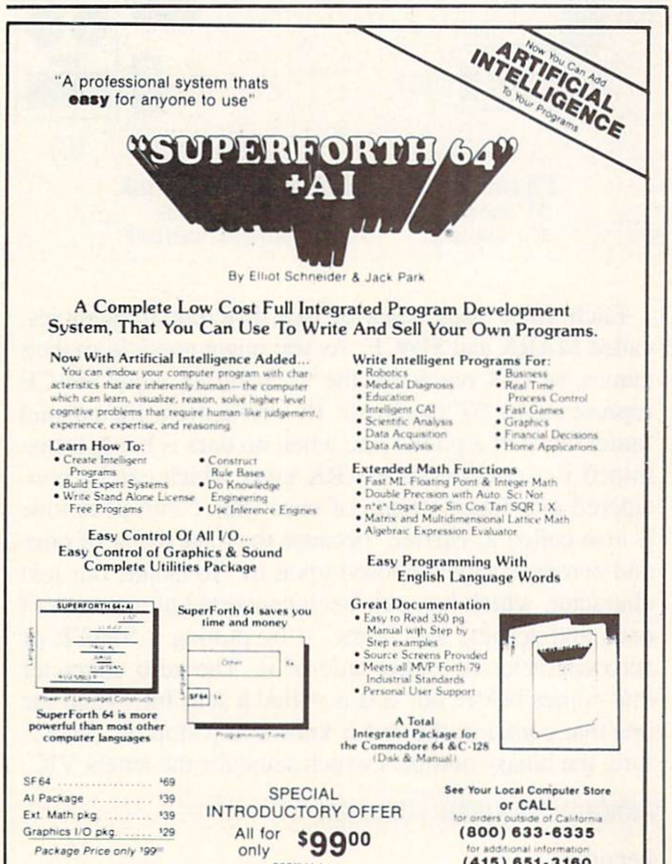
VIC

This may seem like a lot of work for just three letters! Fortunately, your computer and modem can handle the whole operation at a high rate of speed. What speed, you ask? The most common rate is 300 bits per second. As you have seen above, each character requires at least 10 bits, so 300 bps equals a little under 30 characters per second. Sometimes you will hear operation at 300 bps referred to as 300 baud. This unit of measurement is named after Georges Baudot, the inventor of an early teleprinter code. But it refers only to how many times per second the tones change frequency, not how many bits are sent. At 300 bps, the tones change frequency at a rate of 300 baud, so the terms may correctly be used interchangeably to describe the speed of transmission. Modems that transfer data at 1200 bps, however, only change the frequency of the tones at a rate of 600 baud, so to term them "1200 baud" modems is a mistake.

The only term left to explain is "echoplex" or "duplex" mode. This has to do more with how information is displayed on your screen than how it is transmitted. Most communications links are in what is called "full duplex" mode. This means that the remote computer actually echoes back every character that you send it, and the text that you type in at your keyboard does not appear on your screen until it is sent back from the computer on the other end. This makes it easy to spot any trouble, because if the other computer isn't receiving your text, you won't see it on your screen as you type! The other possible mode is called "half duplex." In this mode, all of the characters that you type are displayed directly on your screen. This is necessary only if the remote system isn't echoing your characters back. If it is, then you will see each character on your screen twice, once from the "local echo" and once from the "remote echo," lliikkee tthhiiss.

That about covers our painless introduction to telecomputing. If you have any questions, please send them along, and we'll try to cover them in future columns.

Sheldon Leemon
CompuServe ID 72705,1355
Source BBX878



Reader Service No. 250

SCREEN MAGIC

A Graphics Generator for the C-64

By Bob Spirko

The C-64 provides a variety of graphics, but producing them on the screen is no easy matter. Take for instance the procedure of placing a red, reversed heart symbol in the middle of the screen. First we use the two cursor keys to get to the location. Then we press CTRL and RVS, followed by CTRL and RED. Next we have to find the character on our keyboard...there it is. Now we press COM and S. There. Eight keys later we have our symbol on the screen. That's a lot of work for one character.

Drawing a complex picture in this manner is not something you would do for fun, but sometimes we'll write a program that demands it. Even as I wrote *Screen Magic,* I was wishing I had help.

Screen Magic takes your hands away from the keyboard and places them on that device we all love to handle: the joystick. Using only the joystick, you can choose the character that you want and print it on the screen. These include graphic characters, letters, numbers, and other symbols as well. On the screen, along with the character table, there is a palette of colors. Most of the screen, however, is your canvas. Although you can draw effectively without the keyboard, there are a number of special keys you'll want to use. I'll get to these in a minute; first let's type in the program.

It's in machine language—and it's long—but *Flankspeed* (see page 86) should eliminate all the typos. Once you've typed it in, be sure to save it before running. Then plug your joystick into port 2. Type NEW and hit RETURN. Then type SYS 49152 and press RETURN.

The screen will display a table of symbols and colors—unlike the keyboard, these are neatly grouped together for quick selection. To start, just push your joystick. First you'll have to pick a character to print. Center your cursor, which is an open box, over the symbol you want and press the fire button; the character will be tucked away in a tiny buffer. Then move to the palette and select a color in the same way. Now go to the right side of the screen and hit the joystick button; your character will be printed. You can, of course, hold down the button and draw a string of characters as you move across the screen. Keep in mind that your cursor picks up letters and colors when it's in the symbol table, but outside of the table, it prints them.

As you move about the screen you may find the cursor speed too slow or too fast. To change it, press V and you'll be asked to enter a number. The fastest is 0 and the slowest is 9. You can also use the cursor keys to maneuver around, and the space bar to pick up or drop a character. Use DEL (or print a space) to erase a character, and CLR to clean your canvas. Some characters, such as letters and numbers, have no reverse case displayed in the symbol table, but you can toggle reverse by pressing 9 (press RVS without holding the CTRL key down). When you've finished drawing, press X to exit to BASIC.

Now for those special keys I mentioned. After drawing your picture, you may find that it is not centered on the screen. If this is the case, you can scroll your canvas to the right by pressing f1. Similarly, use f2, f3, and f4 to scroll left, down, and up. To change the background color, press f5. No doubt you'll want to save some of your creations; if so, press f8 and you'll be asked for a file name. Once entered it'll be stored (disk only) for later retrieval. To LOAD it, press f7.

Often you might want to draw a symmetrical figure, such as a border. Tap the back arrow and you'll be in the symmetry mode. Whatever you draw on the left side of your canvas will be duplicated on the right. If your cursor is on the right side of the screen, no duplication takes place. Press the back arrow again to turn off the symmetry mode.

The keys I like most are A and SHIFT-A. Let's say you want to draw a line with hearts and diamonds so that the first character is a heart, the second a diamond, the third a heart, and so on, alternating down the line. If you already have a heart in your buffer, toggle key A. The heart will be transposed to another buffer. Now move your cursor over the diamond and press the fire button. With both characters stashed away, you can now print alternating symbols. Each time one character is printed, the buffers are switched so that the next character to be printed is different. To turn off alternating characters, hit A again. Toggle SHIFT-A to alternate colors.

Here's a rundown on the commands:

f1	: scroll right	f8	: save to disk
f2	: scroll left	←	: symmetry mode
f3	: scroll down	A	: alternate characters
f4	: scroll up	SHIFT A	: alternate colors
f5	: change bkgrd. color	V	: cursor velocity
f7	: load from disk	X	: exit to BASIC

When loading *Screen Magic* back in, you'll have to do so with a ",1":

```
LOAD"SCREEN MAGIC",8,1
```

as it is all ML. When the cursor returns to the screen, type SYS 49152, then RETURN. This will activate the program. ☐ *SEE PROGRAM LISTING ON PAGE 102*



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Reader Service No. 272

DUCK SHOOT

ARCADE ACTION

for the C-64

By Bob Blackmer

Duck Shoot is a colorful arcade-style shooting gallery, inspired by the old carnival game. You simply aim your gun sights at the ducks on the screen and fire.

Shooting down ten ducks will put you in a timed target round, consisting of a series of targets that appear on the screen for brief periods. The higher your score, the faster the required reaction time. If four ducks in a row get by, the game ends and your score and the high score are displayed.

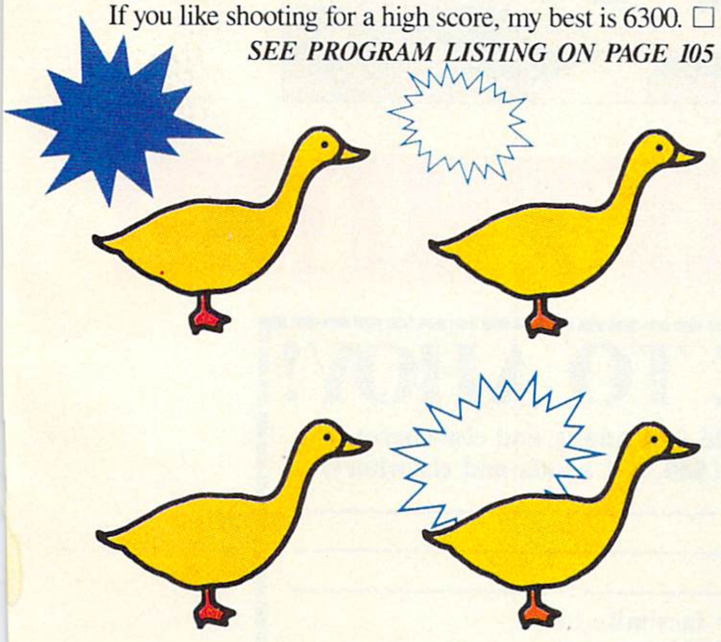
The duck's speed will increase as you progress through the rounds.

Ducks are worth 25 points each, and the targets are worth 50 points each.

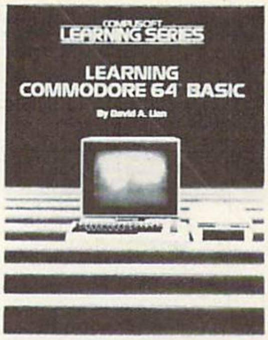
There are eight target rounds, after which the game becomes a flurry of ducks moving faster and faster until the game ends.

If you like shooting for a high score, my best is 6300. □

SEE PROGRAM LISTING ON PAGE 105



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pp. 360

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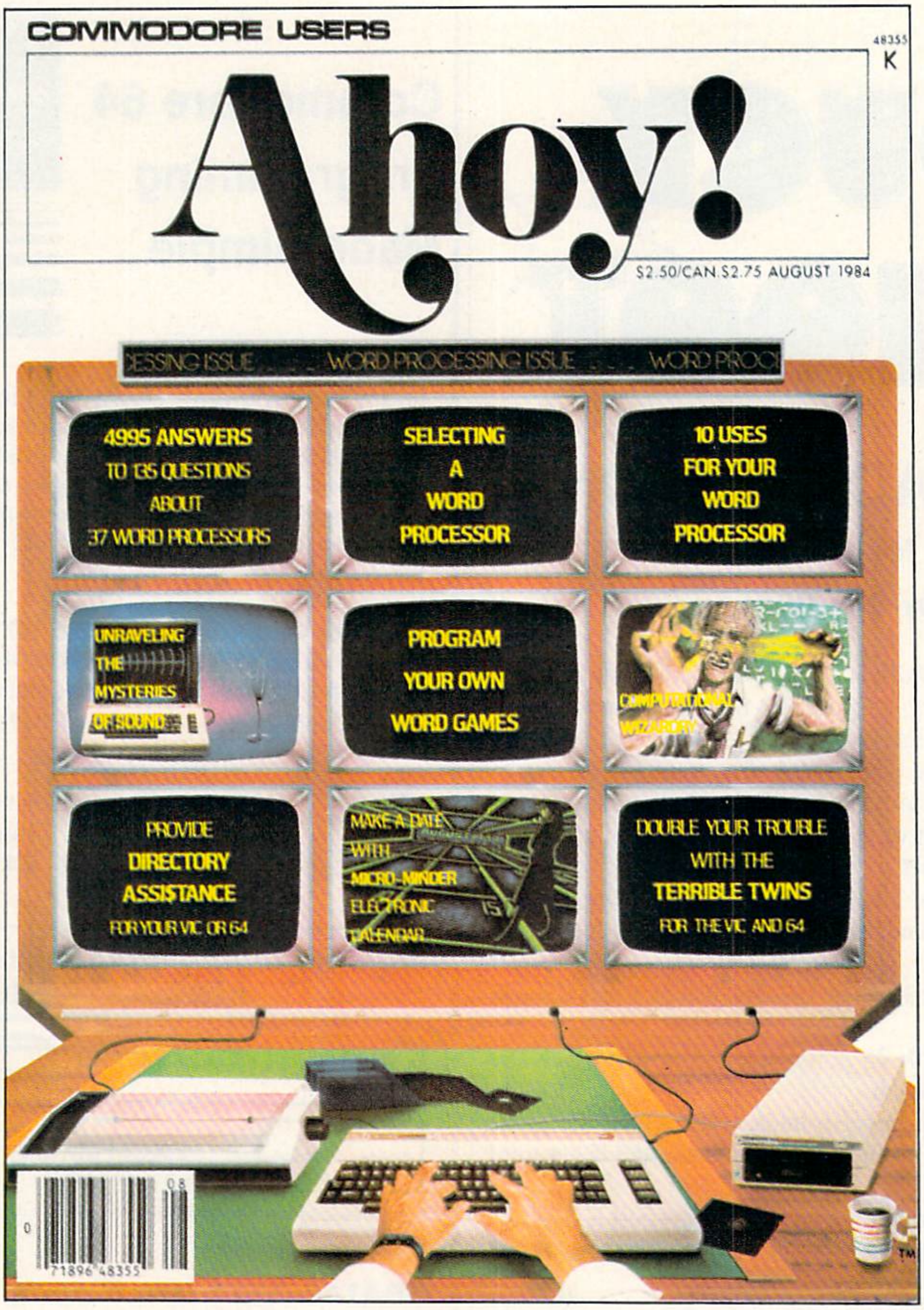
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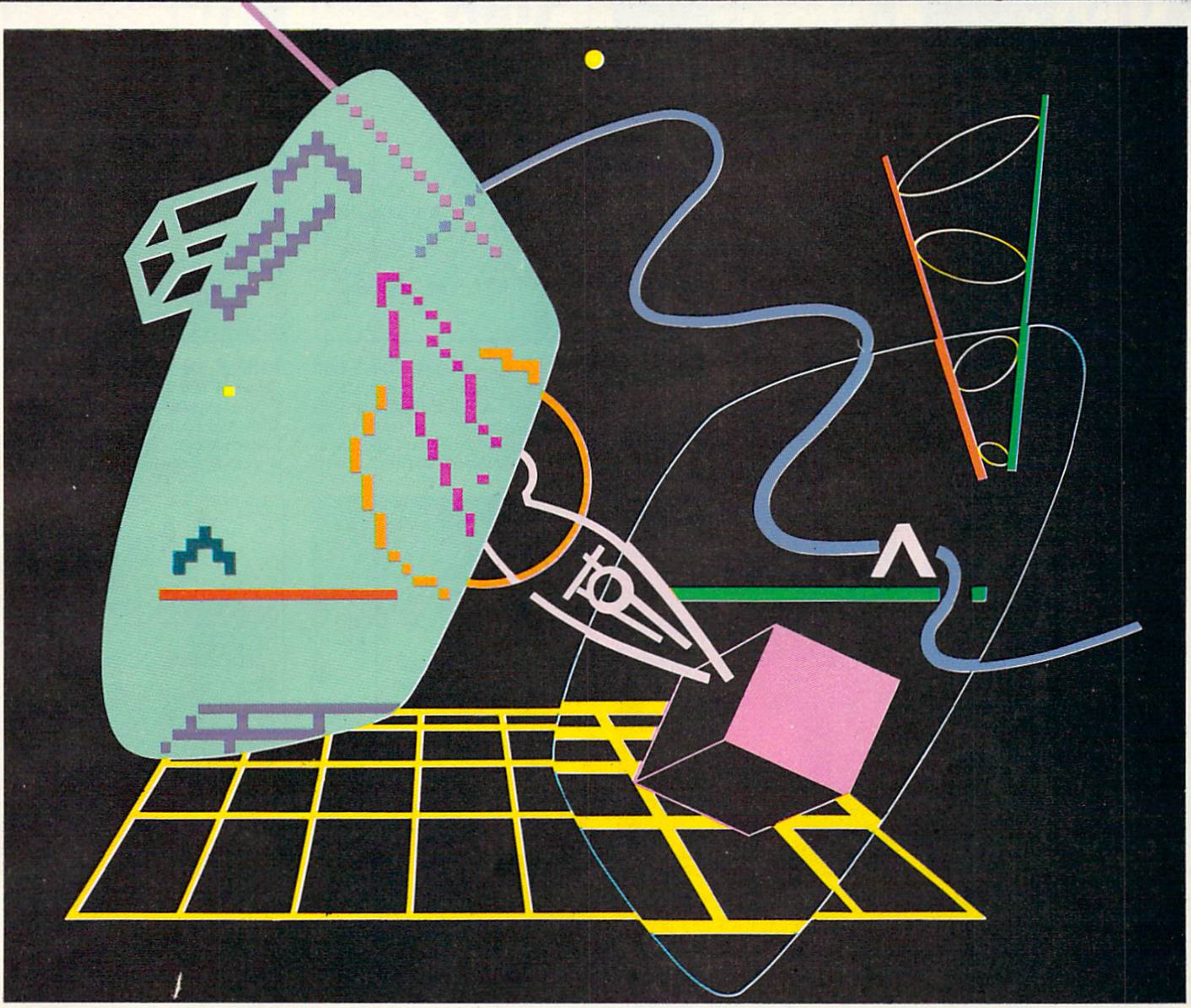
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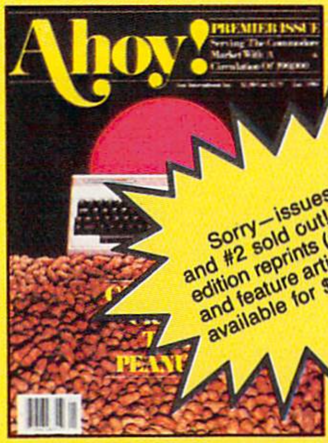
Exploring Bit Map Graphics on the Commodore 64

By Dale Rupert

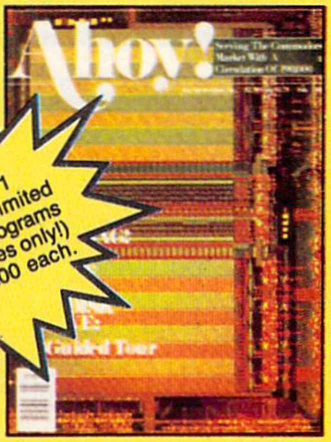
Exploring any new feature of the Commodore 64 is always an adventure. Originally I had planned to deal with the random number generator this month. There are several interesting computer simulations involving random numbers. The Buffon Needle problem and the "infinite number of monkeys at the keyboard" problem can both be simulated by using the RND function in BASIC. Before developing those problems, I wanted to do some elementary investigations into the random number generator itself. That's where this diversion into bit map graphics began.

It is well known from the advertisements that the Commodore 64 has a graphics resolution of 320 dots (horizontal) by 200 dots (vertical). What isn't obvious from the ads is that accessing those 64,000 dots is much easier said than done. All I wanted to do was choose a random value for X from 1 to 320 and a random value for Y from 1 to 200 and then plot each X-Y pair. Truly ran-

Back Issues of Ahoy!



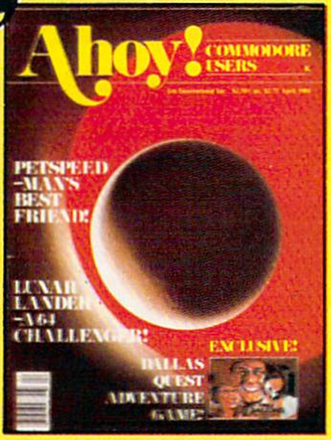
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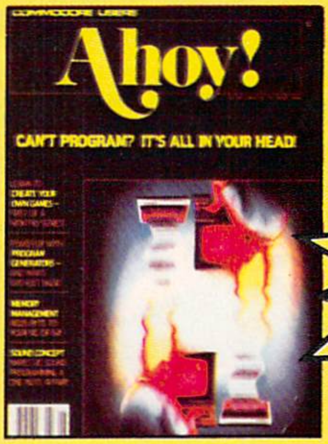
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dom numbers should produce a truly random looking pattern of dots on the screen.

Those of you who use one of the enhanced versions of BASIC are undoubtedly able to type PLOT (X,Y), or something similar, and thereby put a dot on the screen effortlessly. This article is for those of you who do not use a fancy BASIC. Or those of you who enjoy a complicated puzzle and want to find out more about the amazing silicon brains we are using.

This month we will investigate the Standard High-Resolution Bit Map Mode of displaying graphics on the Commodore 64. We will see that BASIC is barely able to operate in this mode. BASIC is very slow and cumbersome at manipulating 64,000 dots in most applications. For that reason, next month we will create some assembly language routines to help speed things up. First let's review some of the basic screen concepts we've previously discussed.

PRELIMINARIES

In the normal character mode of operation, there are twenty-five rows of characters with forty characters in each row. That gives a total of one thousand individual characters (25 times 40) which may be displayed at one time. There are 256 different characters to choose from for each of those 1000 locations. Furthermore, each and every character may be any one of sixteen colors.

The Video Matrix is the technical name for the one thousand consecutive bytes of memory whose contents are normally displayed on the screen. The Video Matrix begins at memory address 1024 and goes to address 2023 when we turn on the computer. Those addresses may be changed by programming, but we will assume that they have not been.

Each byte of the Video Matrix contains an eight-bit value ranging from 0 to 255. In normal character mode, the VIC-II Video Interface Chip translates each byte into a pattern of pixels (picture elements) which appear on the screen in some recognizable form. Appendix E in the *C-64 User's Guide* and Appendix B in the *Programmer's Reference Guide (PRG)* show 128 of the 256 possible forms. The other 128 characters are reverse images of those shown. There are indeed two sets of 256 characters each, but only one of those sets may be selected at a time. In fact it is possible to create still other sets of characters to replace these, but that is a topic for another article.

If we put the value 20 into address 1024 (POKE 1024,20), the result is a letter "T" in the upper left corner of the screen. As we have discussed before, it may not be visible until we put a contrasting color value into the corresponding color memory location (POKE 55296,1). The VIC-II uses the 20 as an index into the Character Base. The Character Base provides a 64 bit dot pattern which represents the character "T". The normal Character Base originates in ROM.

Each character consists of a box which is eight screen dots wide by eight scan lines high. Within that box of 64 dots or pixels, some of the dots are one color and the rest are another color. The dots that contrast with the background color are arranged in the shape of a "T".

To get an idea of the size of the pixels we are dealing with, put character 102 onto the screen (POKE 1024,102 : POKE 55296,1). You might be able to count the individual pixels, depending upon your monitor and your eyes. Each small square in the pattern contains four pixels. Keep in mind that those 64 pixels are generated as a result of the one-byte quantity stored in location 1024.

In graphics bit map mode, the VIC-II treats each one-byte value in locations 1024 through 2023 quite differently. Instead of representing predefined character symbols, each one-byte value is interpreted as two four-bit color codes. In the bit map memory, the "0" bits will be displayed as one color and the "1" bits will be shown as the other color. But just a moment. What is this bit map memory?

THE BIT MAP

We have already calculated that a 320 by 200 resolution display needs 64,000 bits or 8000 bytes of storage. The C-64 hardware is arranged so that the 8000 byte bit map memory may begin at either location 0 or location 8192. Since BASIC and the operating system are very dependent on the page zero memory, we wouldn't get very far by POKEing random data there. Consequently we must use the 8000 bytes beginning at address 8192 for our bit map memory.

Having defined a suitable block of memory, we can create an image on the screen by turning some of the 64,000 bits on and turning others off. The first eight bytes of this memory contain 64 bits which correspond to the small, character-sized region in the upper left hand corner of the screen. The bits that are 1's will be displayed as one color, and those that are 0's will be displayed as another color. The actual colors depend upon the value stored in location 1024. The next block of 64 pixels will also be displayed in two colors. Those colors are determined by the value stored in location 1025. And so forth.

There is a very definite similarity between the character mode and the bit map graphics mode. Each mode has a data memory and a separate color memory. For character mode, data memory consists of 1000 bytes beginning at location 1024. Its color memory consists of 1000 nybbles beginning at location 55296. Each of the 1000 characters may have any one of sixteen colors. For bit map mode, data memory consists of 8000 bytes beginning at location 8192. The corresponding color memory begins at location 1024. Each of the 1000 bytes starting at 1024 contain two color nybbles. Each block of eight bytes in data memory can be displayed in any two of sixteen possible colors. As we discuss the details, the confusion should subside.

THE DETAILS

Pick two colors, any two colors, as long as they are from the group of sixteen listed in Appendix G of the

User's Manual or Appendix D of the *PRG.* A number 20 in location 1024 while in bit map mode is interpreted as the colors white and purple. The easiest way to see this is to convert it to hexadecimal. In hexadecimal, 20 becomes $14 where the "$" signifies that this is a hexadecimal value.

The "4" is in the units place, and "4" corresponds to purple. The "1" representing white is in the 16's place. The decimal value of $14 is 1*16 + 4 or 20. That is how the value 20 in location 1024 represents the colors white and purple.

If you want the 64 pixels in the upper left corner of the screen to be light blue or yellow, you must poke 231 into address 1024. Light blue has a value of 14, and yellow has a value of 7 (14*6 + 7 = 231). The color value in the most significant nybble is treated as the foreground color, and the other is the background color. Poking 126 into 1024 would reverse the colors since 7*16 + 14 = 126.

A simple example should clarify the situation. Assume we are working in bit map mode, and location 1024 contains the value 20 (white/purple). Put values 255,0,255, 0,255,0,255,0 into the first eight locations starting at address 8192. Remember that these eight bytes represent the pixel pattern displayed in the upper left corner of the screen. That eight by eight square will look like this:

```
11111111
00000000
11111111
00000000
11111111
00000000
11111111
00000000
```

The number 255 contains all 1's, and of course 0 is stored as all 0's. The computer does not display 1's and 0's on the screen. Instead all the 1's are displayed as white pixels, and all the 0's are shown as purple pixels. Consequently there will be a white and purple striped square in the upper left corner of the screen.

If we replace the 255 in location 8192 with 254, the pixel in the upper right corner of the box above will change from white to purple. If we put the value 1 into memory location 8199, the lower right corner of the box will change from purple to white. If we change the value in location 1024 from 20 to 231, the box will change from white and purple stripes to light blue and yellow stripes as we calculated earlier.

It should now be clearer as to where the term "bit map graphics" originates. The value of each bit corresponds to a pixel on the screen. The screen image is essentially a map of the bits in memory.

The details of the organization of the 8000 byte bit map memory are shown on page 125 of the *PRG.* Unfortunately the calculations needed to determine the specific byte and bit to turn on any given pixel on the screen are somewhat involved.

Using the terminology in the *PRG,* the formulas for locating the pixel at location X,Y are as follows:

BYTE = BASE + 320*ROW + 8*CHAR + LINE
BIT = 7 − (X AND Y)

where

BASE = 8192 (the starting address of the bit map)
ROW = INT(Y/8)
CHAR = INT(X/8)
LINE = (Y AND 7)

The calculated BIT is set to 1 or reset to 0 in address BYTE in order to select the foreground color or the background color for the pixel at screen location X,Y. X ranges from 0 to 319 and Y ranges from 0 to 199 with the origin 0,0 in the upper left corner of the screen.

Unfortunately these formulas represent a fair amount of work for BASIC to locate just one pixel. You enter the bit map mode in BASIC only if you have plenty of time. Let's look at the details of initiating bit map mode and working in it.

USING THE BIT MAP

The steps required for using bit map mode are as follows:

1. Set the bit map starting address to 8192.
2. Enter bit map mode.
3. Clear the bit map memory.
4. Put desired color(s) into the color memory.
5. Set (or reset) desired bits in bit map memory.

The sequence for these steps depends upon the application. The program on page 88 shows how these steps are implemented.

We will use the "set bit" and "reset bit" functions which we have discussed in previous columns. They are defined in lines 10 and 20. Line 420 shows how these functions are used. The argument of the function must be a number from 0 to 7 corresponding to the chosen bit. The memory location must be stored in the variable named MM. The statement POKE MM, FNSB(5) will set bit 5 of address MM to 1. If BIT has a value of 3 and MM equals 9000, then POKE MM,FNRB(BIT) will reset bit 3 of location 9000 to 0.

To place the bit map memory at address 8192, we must set bit 3 of VIC-II register 24. ("Set" will mean to give a value of one and "reset" will mean to give a value of zero in the following discussion.) The VIC-II registers begin at location 53248. Register 24 is at address 53248 + 24. The variable VV in line 30 stores the starting address of the VIC-II registers. Line 40 sets bit 3 of register 24 and defines the starting location of bit map memory.

To enter bit map mode, line 50 sets bit 5 of VIC-II register 17. If you stop the program at this point, you see a jumble of dots, especially if the screen had characters on it before you typed RUN. The eight by eight demarcations should be visible as the colors vary from box to box. The colors are determined by the characters which were on the screen when you ran this program. The dots within the boxes show the data that happened

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to be in memory beginning at location 8192 when you ran the program.

Lines 70 and 80 POKE 0 into the 8000 bit map locations. This seems to take forever. (A good place for a machine language routine!) The whole screen will now display the background color(s).

Line 90 sets the foreground color C1 to white (1) and the background color C0 to black (0). Not very imaginative, but feel free to pick your own colors. The 1000 bytes of color memory are filled with this one color combination in line 100. Remember, you may put various color combinations anywhere within the color memory.

The main program in lines 200 through 220 performs the operation described at the start of this article. Random values for X and Y are chosen, and the corresponding X-Y pixel is turned on (set to the foreground color). The main program calls the subroutine at lines 400 through 430, which performs the calculations for an X-Y pair and lights the proper pixel. Notice that some of the formulas mentioned earlier have been combined into one formula in line 410 to help speed things up.

A pause in line 250 allows you to see the screen for a while after the one thousandth random pixel has been lit. Lines 310 and 330 return things to normal character mode. All the characters which were on the screen are now P's. Do you know why? Look at line 100 for a clue. List the program to see that everything is in fact normal.

Here are a few tips before you take off on your own to work with this graphics mode. Remember that RUN-STOP/RESTORE will return the screen to normal mode. I found it useful to memorize the line number 300. If I stopped the program before it finished, I would blindly type GOTO300 which allowed the program to return the screen to normal. That way my screen colors weren't reset as they would be with RUN-STOP/RESTORE.

It is very frustrating to sit and wait for 8000 bytes of memory to be cleared every time the program is run. You might put in a statement to bypass lines 70 and 80 after memory has been cleared once. You will end up with multiple images on the screen but that may not be objectionable for debugging.

Put your own statements between lines 100 and 300. Just define values for X and Y then GOSUB 400. This program does not check the validity of any parameters, so be careful with your values of X and Y, or add checking routines (and slow the program down even more).

Horizontal and vertical lines are easily generated. A sequence such as this creates a small rectangle:

```
200 FOR X=100 TO 130
210 Y=20 : GOSUB 400
220 Y=40 : GOSUB 400
230 NEXT X
240 FOR Y=20 TO 40
250 X=100 : GOSUB 400
260 X=130 : GOSUB 400
270 NEXT Y
```

These instructions from the *PRG* draw a sine wave:

```
200 FOR X=0 TO 319 STEP 0.5
210 Y=INT(90 + 80*SIN(X/10))
220 GOSUB 400
230 NEXT X
```

There is a warning on page 127 of the *PRG* that BASIC variables can overlay the high resolution screen. It is clear from the memory map on page 320 of the *PRG* that our bit map memory (8192 to 16191) is in the midst of the BASIC program space. BASIC closes in on this bit map memory from both directions. This is all right if the two regions don't reach the bit map memory. If your program is so large that an overlap occurs, you will have to move the bottom of BASIC memory up above address 16191. The TXTTAB pointer at locations 43 and 44 determines the lowest address used by your BASIC program. Change this if your programs conflict with bit map memory.

It's obvious after running the program on page 88 that the random number generator doesn't generate patternless random numbers. We'll go further with random numbers another time. Next month we'll replace some of these sluggish BASIC statements with high-speed assembly routines. In the meantime, what will you do with those 64,000 pixels now that you have control of them? ☐

SEE PROGRAM LISTING ON PAGE 88

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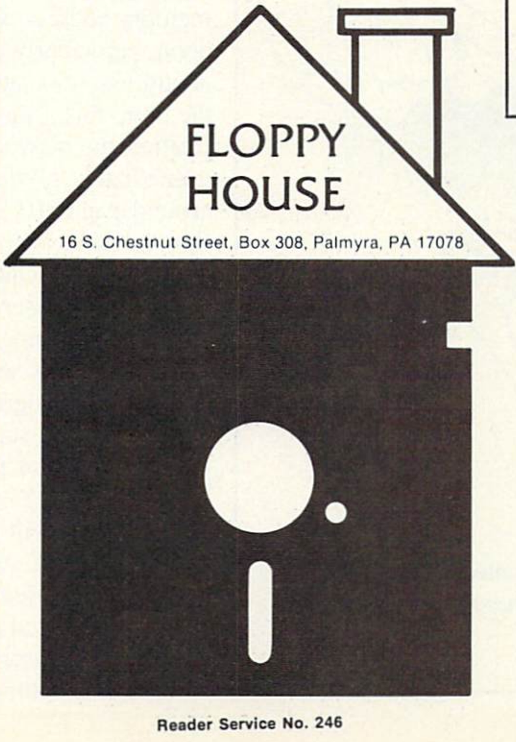
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MAPPING THE COMMODORE 64 by Sheldon Leemon (COMPUTE! Publications, Inc., 1984; $14.95). 268 pages, 65536 memory locations, softbound.

Mention memory map to a veteran peruser of computer journals and you will conjure up a vision of a nearly endless column of numbers, flanked by cryptic labels to the left and equally cryptic descriptive messages to the right. While this sort of information is eminently useful to those familiar with the innermost secrets of their computer, it provides the average user with very little that's definitive.

Mapping The Commodore 64 is a memory map with a difference. The list of numbers (in hexadecimal and decimal) is still there along with the cryptic labels and associated comments. However, comparing this book to a memory map is akin to comparing a detailed travel guide to a simple road map. Each significant address or group of addresses is annotated in considerable–yet concise–detail. These are not just one or two sentence descriptions. The shortest explanations run several paragraphs. The longest are actually comprehensive tutorials on the specific features on the Commodore 64.

For example, the memory locations devoted to the VIC chip comprise a surprisingly thorough description of the graphics capabilities of the Commodore 64. This book by my side proved a valuable aid in preparing the graphics articles for the October and November issues of *Ahoy!* Actually, the entire C-64 4K I/O block (53248-57343; $D000-$DFFF) spans nearly 100 pages.

The layout follows the memory arrangement of the C-64. Thus chapter 1 is entitled "Page 0" in reference to the machine language notation for the first 256 bytes (0-255) of available memory. This has nothing to do with the page numbering of the book. As a result, the book lacks a definitive topical organization other than that which may be associated with a specific memory block. Beginners should take warning. Some idea of what you are looking for is needed to comfortably find your way around this format. Detailed explanations of specific locations are often associated with other addresses which may be further on in the text.

Specific areas of emphasis are the first kilobyte of RAM (used by BASIC and the operating system) and the ROMs themselves. Most of the addresses in the first group include useful hints and tips on the effect of modifying the contents of the particular location. The second group is broken down into the specific operating system routines. Brief descriptions are provided on just what each routine does.

Sprinkled throughout are program examples in both BASIC and ML which are used to illustrate the various points. These range from brief one or two line affairs to full blown utilities. For example, the Vector to Keyboard Table Setup Routine, addresses 655-656 ($28F-$290), includes a C-64 version of a keypress routine which generates an entire BASIC keyword from a single SHIFTed or COMMODOREd keystroke.

The index was a bit unusual. Rather than the customary page numbers, each item was referenced to its actual memory address. On occasion this proved to be a minor boon, particularly when all that was needed was the actual address associated with the item in question. Most of the time, this arrangement was less than optimum as the relationship between page numbers and address was not immediately obvious (let's see now, 56576 should be around page 203 or thereabouts...). The most serious flaw in this system was trying to find my way around the I/O block, which in the C-64 is multilayered. Tracking down the description of the character generator ROM took a little doing.

The appendix section was surprisingly brief, consisting only of a program typing guide and a list of the Commodore ASCII, screen, color and key codes. You definitely get a lot of meat in this volume.

Mapping the Commodore 64 is a must-have for anyone serious about using the 64 for anything other than running canned software. For beginners, appreciation will increase directly with their computational sophistication. Advanced users will find many surprises within its covers. All users will find it a valuable aid in working with their machine. ☐ *–Morton Kevelson*



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MAPPING 4.4

A Function Plotter for the C-64

This program will provide assistance in solving numerous problems in physics, mathematics, and other fields where it is necessary to see the behavior of a mathematical function. It will plot a function, in high resolution, into a given range on a small screen (which is large enough for most applications). It is practically error-proof and easy to use, employing the same principles as bit map graphics, but over a screen of only 9600 pixels (120 * 80). The user can specify the portion of the function he wants depicted, and change the function.

For programmers, the listing on page 109 is easy to understand. It is composed almost entirely of subroutines, and contains many REM's throughout.

HOW TO USE THE PROGRAM

On the bottom of the screen, the names of all the keys that can be used are displayed. Their functions are as follows:

f1: Graph Cleaner. Clears the small screen, but not the equation. You can ask for another range without respecifying the function.

f3: Range Changer. When you press this key, the program will request the minimum value (XO) and the maximum value (XM) on the X-Axis into which you want to plot the function. It will then request the minimum and maximum values on the Y-Axis (YO, YM). It will then ask for the number of pixels you want to use in making the graphic. The plotting will follow this last input.

f5: Function Changer. Changes the function in the program. It is located on line 55 of the program. After this operation the values of all the variables vanish, due to the fact that the program is ENDed and then RUN again.

f7: Compare with Memory. This key, when pressed once, shows the graphic on the screen together with the one in memory, in order to allow you to compare them. When you press the key again, it returns the screen to its original condition.

f2: Store M+. When this key is pressed, any graphic on the screen is copied into memory over any graphic residing there.

f4: Recall. Calls the graphic in memory back, and puts it on the screen over any graphic that is there.

f6: Clear Memory. □

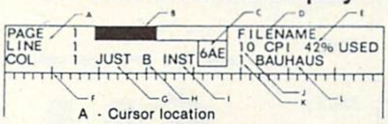
SEE PROGRAM LISTING ON PAGE 109

By J.M. Marcano



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On Screen Status Display



A - Cursor location
B - Scroll Indicator
C - Print features currently being used
D - Filename of text
E - Percentage of RAM (memory) used
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I - Insert mode flag
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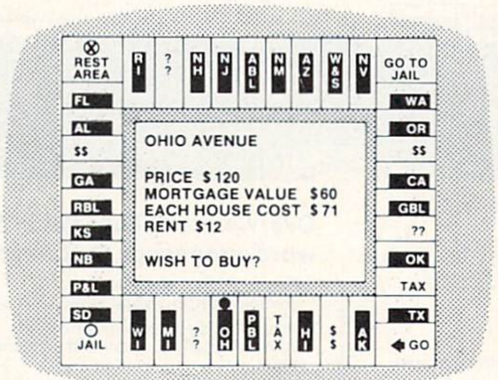
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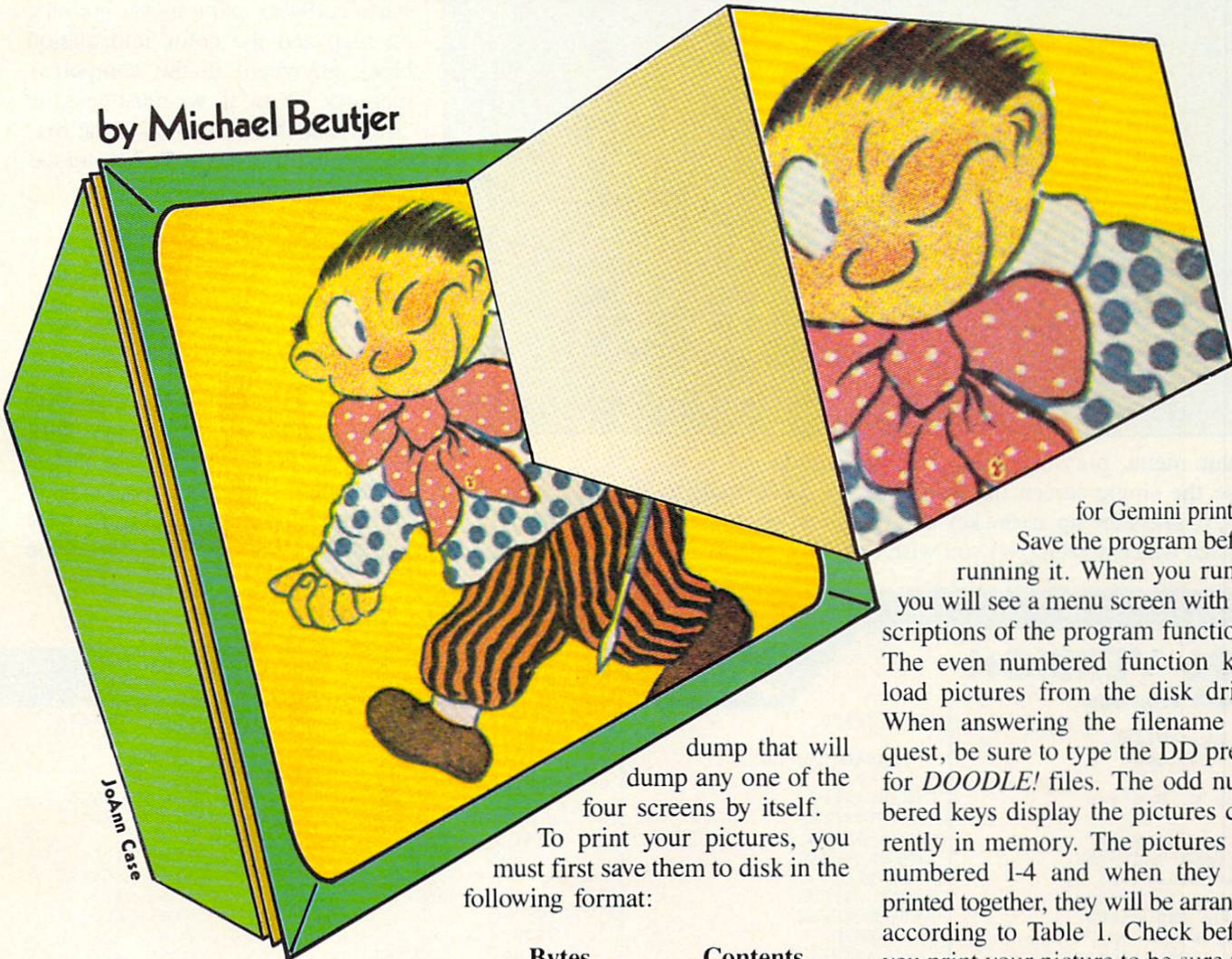
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QUAD-PRINT

A Screen-Dump Utility for the C-64

by Michael Beutjer



Almost everyone loves to doodle, and your 64 is a great place to do it! Whether you use a light pen, joystick, trackball, or write special programs to make your high resolution screens, the 320 x 200 sketch pad in your Commodore 64 is just plain fun. Sometimes, though, that doesn't seem to be enough. So why not 640 by 400?

That's exactly what you'll get with *Quad-Print,* a printer utility that dumps four hi-res screens together to form one big picture. Versions are provided to work with the Commodore 1526, Epson, or Gemini printers. With a little work, you can probably use any printer. Included within the 1526 version is a single screen dump that will dump any one of the four screens by itself.

To print your pictures, you must first save them to disk in the following format:

Bytes	Contents
0 - 1023	Screen Memory
1024 - 9023	Hi-res Bit map

This is compatible with disk files created with *DOODLE!* from City Software, so you can use those pictures directly. Note that the color memory section is used only for displaying the pictures, not in the printout. Making edges match is a little tricky at first, but with a little practice it becomes much easier.

The 1526 version begins on page 95, and the Epson/Gemini version on page 97. If you type in the Epson/Gemini version, only the set of control code lines (1140 - 1190) corresponding to your printer should be typed. The number in line 565 must also be changed from 61145 to 61166 for Gemini printers.

Save the program before running it. When you run it, you will see a menu screen with descriptions of the program functions. The even numbered function keys load pictures from the disk drive. When answering the filename request, be sure to type the DD prefix for *DOODLE!* files. The odd numbered keys display the pictures currently in memory. The pictures are numbered 1-4 and when they are printed together, they will be arranged according to Table 1. Check before you print your picture to be sure you have the four screens arranged properly. If you need to swap pictures from one place to another, use the @ key from the main menu and enter the numbers of the screens you want to swap. Notice that your picture names are printed at the top of the menu screen to help you keep track of them.

Other program functions are positive or negative dump (English pound sign or left arrow key, respectively), and quick view screens (asterisk) which display the pictures in "slide show" fashion. To use the quick view feature, press the asterisk key from the main menu. Screen 1 will be displayed, and you may cycle through the screens by pressing the odd numbered function keys. To return to the

TABLE 1

Picture No.	Address	Position
1	$4000	Top Left
2	$6000	Top Right
3	$8000	Bottom Left
4	$A000	Bottom Right

TABLE 2

ML Routine	Epson/Gemini Address	1526 Address
Move Picture	49490	49430
Display on/off	49188	49188
Dump positive	49209	49209
Dump negative	49205	49205
Load picture	49454	49374

Note that all "POKE" values are the same for either version.

main menu, press the space bar. To use the single screen dump for the 1526, press the up arrow key and indicate which screen (1-4) you wish to dump.

Let's look at the Epson/Gemini version to see how it works. (The 1526 version works in generally the same way and the SYS addresses for it are in Table 2.) There are four machine language subroutines that the BASIC program uses to handle the jobs of loading, moving, and printing your pictures. The move routine starts at 49490, and it moves both the bit map and the color information block anywhere in the computer's memory. To use it, we must pass the "from" and "to" addresses to the routine. POKE the desired addresses as follows:

POKE	Value
49152	Bit Map : From
49153	Bit Map : To
49154	Color Info : From
49155	Color Info : To

We need only POKE the high byte of these addresses – the low byte must always be zero. The routine moves the two areas independently; it is up to us to keep track of where we have put them. We may use any of the

QUAD - PRINT SOURCE CODE LISTINGS

1526 VERSION
Main Routine

```
 ;
 ;  Quad-Print
 ;   (C) 1984
 ;
 ; by M. Beutjer
 ;
 ; This program
 ; dumps 4 hi-res
 ; screens side by
 ; side to produce
 ; one 640 x 400
 ; printout on
 ; a 1526 printer.
 ;
 ;
        *=$C000
 ;
 ; DATA AREA
 ;
ORIG   .BYTE  0
DEST   .BYTE  0
CORIG  .BYTE  0
CDEST  .BYTE  0
LENGTH .BYTE  0
NAME   *=*+16
PBLOCK .BYTE  0,0,
       0,0,0,0,0,0
ROWCNT .BYTE  0
COLCNT .BYTE  0
FCSAVE .BYTE  0
FBSAVE .BYTE  0
REVRSE .BYTE  0
TEMP   .BYTE  0
FLAG   .BYTE  0
 ;
 ; LABEL DEFINITIONS
 ;
SCREEN=$2000
SCRN1=$4000
SCRN2=$6000
SCRN3=$8000
SCRN4=$A000
CODES=$C1D0
POINTR=$FB
 ;
 ; KERNAL LABELS
 ;
CHKOUT=$FFC9
CHROUT=$FFD2
CLOSE=$FFC3
CLRCHN=$FFCC
OPEN=$FFC0
SETLFS=$FFBA
SETNAM=$FFBD
LOAD=$FFD5
CLALL=$FFE7
STOP=$FFE1
UNLSN=$FFAE
 ;
 ;   PROGRAM AREA
 ;
 ; TURN HIRES SCREEN
 ;     ON OR OFF
DISPL  LDA    $D011
       EOR    #$20
       STA    $D011
       LDA    $D018
       EOR    #$08
       STA    $D018
       RTS
 ;
 ;      DUMP ROUTINE
 ;
 ; NEGATIVE ENTRY
REV    LDA    #255
       BNE    STORE
 ;
 ;   NORMAL ENTRY
NOREVS LDA    #0
STORE  STA    REVRSE
       JSR    COPEN
 ;   POINT TO
 ;   SCREEN 1 & 2
       LDA    #<SCRN1
       STA    POINTR
       LDA    #>SCRN1
       STA    POINTR+1
       LDA    #<SCRN2
       STA    FBSAVE
       LDA    #>SCRN2
       STA    FCSAVE
 ;   25 ROWS PER SCREEN
 ;   PRINT 2 SCREENS
       LDA    #25
       STA    ROWCNT
       JSR    ROW
 ; POINT TO
 ; SCREEN 3 & 4
       LDA    #<SCRN3
       STA    POINTR
       LDA    #>SCRN3
       STA    POINTR+1
       LDA    #<SCRN4
       STA    FBSAVE
       LDA    #>SCRN4
       STA    FCSAVE
 ; PRINT 2 MORE!
       LDA    #25
       STA    ROWCNT
       JSR    ROW
QUIT   JSR    CFIN
       RTS
 ;
 ; DO 25 ROWS
 ; OF 80 COLUMNS
 ;
 ; SEND GRAPHICS
ROW    JSR    CLFD
 ; SEND 40 COLUMNS
       JSR    DOCOL
 ; SAVE POINTER
       LDA    $FB
       PHA
       LDA    $FC
       PHA
 ; POINT TO
 ; SECOND SCREEN
       LDA    FBSAVE
       STA    $FB
       LDA    FCSAVE
       STA    $FC
 ; SEND 40 MORE
 ; COLUMNS
       JSR    DOCOL
 ; RESTORE SCREEN
 ; POINTERS
       LDA    $FB
       STA    FBSAVE
       LDA    $FC
       STA    FCSAVE
       PLA
       STA    $FC
       PLA
       STA    $FB
 ; CHECK STOP KEY
       JSR    STOP
       BNE    NOQUIT
       PLA
       PLA
       JMP    QUIT
 ; NEXT ROW
NOQUIT DEC    ROWCNT
       BNE    ROW
       RTS
 ;
 ;   PRINT 40 COLUMNS
 ;
DOCOL  LDA    #40
       STA    COLCNT
COLUMN LDY    #0
ROTATE LDX    #0
 ; TURN OFF BASIC ROM
       SEI
       LDA    #46
       STA    1
       LDA    (POINTR),Y
       STA    TEMP
 ; TURN ON BASIC ROM
       LDA    #47
       STA    1
       CLI
 ; SHIFT BITS INTO
```

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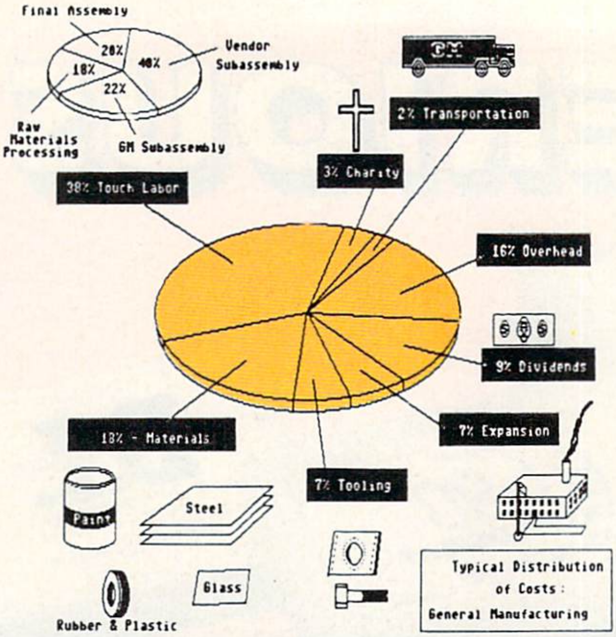
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Quad-Print dump on a Gemini 10X printer.

C-64's RAM including "under" the kernal or BASIC, but to avoid conflicts the BASIC program doesn't store screen maps between $0000 and $1C00 or $C000 to $CFFF.

The display on/off routine toggles hi-res display on or off. The picture's bit map must already be at 8192 ($2000), and the screen memory section must be at 1024 ($0400). The BASIC program uses the move routine to copy the desired picture into position, and the second to turn it on for viewing. When you are finished viewing it, calling the second routine again will turn it off.

The load routine is done from machine language so that the address header of the disk file may be ignored easily. The routine loads the bit map file in the display area so that there are no conflicts with already loaded pictures. It is then moved to the desired location. Before using this routine, the filename must be POKEd into the filename area at 49157, and the filename length must be POKEd into 49156.

The print routine has two entry points: 49209 and 49205 for normal and negative printouts respectively. Table 1 gives the start address of the bit maps which are printed. Printer

```
; PRINT AREA
DOTS    ASL    TEMP
        ROL    PBLOCK,X
        INX
        CPX    #8
        BNE    DOTS
        INY
        CPY    #8
        BNE    ROTATE
        CLC
; BUMP BIT MAP POINTER
        LDA    POINTR
        ADC    #8
        STA    POINTR
        LDA    POINTR+1
        ADC    #0
        STA    POINTR+1
        LDX    #0
; SEND TO 1526
PRINT   JSR    CSEND
        DEC    COLCNT
        BNE    COLUMN
        RTS
;
;  LOAD A DOODLE FILE
;     AND MOVE IT.
;
; OPEN 1,8,0
SCRNLD  LDA    #1
        LDX    #8
        LDY    #0
        JSR    SETLFS
        LDA    LENGTH
        LDX    #<NAME
        LDY    #>NAME
        JSR    SETNAM
        LDA    #0
        TAX
; LOAD DOODLE AT 1C00
        LDY    #$1C
        JSR    LOAD
        LDA    #1
        JSR    CLOSE
        JSR    CLRCHN
        RTS
;
; MOVE A DOODLE FILE
; FROM HI=ORIG LO=00
; TO: HI=DEST LO=00
;
        LDY    #0
        STY    $FB
        LDX    DEST
        STX    $FC
        STY    $FD
        LDX    ORIG
        STX    $FE
        STX    TEMP
M1      INC    TEMP
        INY
        CPY    #$20
        BNE    M1
        LDY    #0
MOVE    SEI
        LDA    #46
        STA    1
        LDA    ($FD),Y
        STA    ($FB),Y
        LDA    #47
        STA    1
        CLI    -
        INY
        BNE    MOVE
        INC    $FC
        INC    $FE
        LDA    $FE
        CMP    TEMP
        BNE    MOVE
        LDA    CDEST
        STA    $FC
        LDA    CORIG
        STA    $FE
        LDX    #4
        SEI
        LDA    #40
        STA    1
CMOVE   LDA    ($FD),Y
        STA    ($FB),Y
        INY
        BNE    CMOVE
        INC    $FC
        INC    $FE
        DEX
        BNE    CMOVE
        LDA    #47
        STA    1
        CLI
        RTS
CRSR    .BYTE  0
        .LIB   QUICKQ1526
        .LIB   SING1526
        .END
```

Fast Dump Routine

```
;
; Fast 1526 graphic
; dump routine
; for Quad Print
;
; OPEN4,4,255 (DATA)
COPEN   LDA    #4
        TAX
        LDY    #255
        JSR    SETLFS
        LDA    #0
        JSR    SETNAM
        JSR    OPEN
        BCS    CO1
; OPEN6,4,6(SPACING)
        LDA    #6
        TAY
        LDX    #4
        JSR    SETLFS
        LDA    #0
        JSR    SETNAM
        JSR    OPEN
        BCS    CO1
; OPEN 5,4,5
; (PROGRAM CHAR.)
        LDA    #5
        TAY
        LDX    #4
        JSR    SETLFS
        LDA    #0
        JSR    SETNAM
        JSR    OPEN
        BCS    CO1
        JSR    SETSPC
        CLC
CO1     RTS
; SET SPACING TO"21"
SETSPC  LDX    #6
        JSR    CHKOUT
        LDA    #21
        JSR    CHROUT
        LDA    #13
        JSR    CHROUT
        JSR    UNLSN
        JSR    CLRCHN
.; SEND A LINEFEED
CLFD    LDX    #4
        JSR    CHKOUT
        LDA    #13
        JSR    CHROUT
        JSR    UNLSN
        JSR    CLRCHN
        LDA    #0
        STA    CRSR
        RTS
; THIS ROUTINE
; PERFORMS
; THE SEND FUNCTION.
; BEFORE THE NEW
; CHAR IS PROGRAMMED
; IT IS CHECKED
; AGAINST THE
; OLD CHARACTER TO
; AVOID UNNECESSARY
; CARRIAGE RETURNS.
CSEND   JSR    CHECK
; SEND OLD CHAR.
        BEQ    CSN1
        LDX    #4
        JSR    CHKOUT
        LDA    #141
        JSR    CHROUT
        JSR    UNLSN
        JSR    CLRCHN
        LDX    #5
        JSR    CHKOUT
        LDX    #0
SEN1    LDA    PBLOCK,X
        EOR    REVRSE
        JSR    CHROUT
        INX
        CPX    #8
        BNE    SEN1
        JSR    UNLSN
BIAS    LDX    #4
        JSR    CHKOUT
        LDX    CRSR
BI1     BEQ    BI2
        LDA    #32
        JSR    CHROUT
        DEX
        JMP    BI1
```

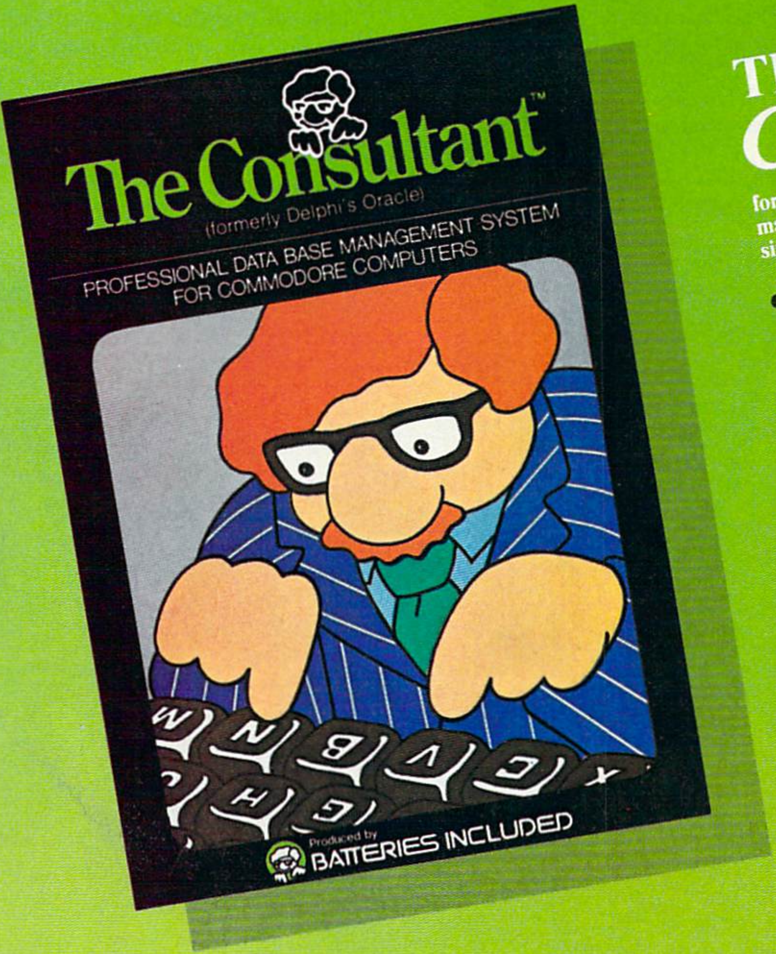
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Single screen dump on a Commodore 1526 printer.

setup information for the Epson/Gemini version is contained in the modules at the end of the DATA statements. The first byte of each command contains the number of bytes in the command string followed by the actual string. The line spacing command area begins at 49600 ($C1C0); the line graphics setup command begins at 49608 ($C1C8). If you have a printer other than Epson or Gemini, you will need to change these values to those recognized by your printer. This will not guarantee that the routine will work, because there are differences in the way printers translate graphics codes into print patterns. The Epson and Gemini patterns print bit 7 at the top and bit 0 at the bottom of each column of eight dots of graphics byte. If your printer is different, you may need to do another translation of the printer codes before you print them; however you will have to use the source code (reproduced on these pages) and an assembler to do this.

```
BI2     INC     CRSR
        LDA     #254
        JSR     CHROUT
        JSR     UNLSN
        JSR     CLRCHN
        JSR     PBLSV
        RTS
; DONE. CLOSE CHANS.
CFIN    JSR     CLFD
        LDX     #6
        JSR     CHKOUT
        LDA     #24
        JSR     CHROUT
        LDA     #13
        JSR     CHROUT
        JSR     UNLSN
        JSR     CLRCHN
        JSR     CLALL
        RTS
; SEND SAME CHAR AGAIN
CSN1    LDX     #4
        JSR     CHKOUT
        LDA     #254
        JSR     CHROUT
        JSR     UNLSN
        JSR     CLRCHN
        INC     CRSR
        RTS
CHECK   LDX     #0
CHK1    LDA     PBLOCK,X
        CMP     PBSAVE,X
        BNE     CKOUT
        INX
        CPX     #8
        BNE     CHK1
CKOUT   RTS
PBLSV   LDX     #0
PBL1    LDA     PBLOCK,X
        STA     PBSAVE,X
        INX
        CPX     #8
        BNE     PBL1
        RTS
PBSAVE  .BYTE 0
        .END
```

Single Screen Dump

```
;This routine sends
;a single 1526 pic.
REV1    LDA     #255
        BNE     STORE1
NOREV1  LDA     #0
STORE1  STA     REVRSE
        JSR     COPEN
        LDA     #0
        STA     POINTR
        LDA     ORIG
        STA     POINTR+1
        LDA     #25
        STA     ROWCNT
ROW1    JSR     CLFD
        JSR     DOCOL
        JSR     STOP
        BNE     NOQ1
        JMP     DONE
NOQ1    DEC     ROWCNT
        BNE     ROW1
DONE    JSR     CFIN
        RTS
        .END
```

EPSON/GEMINI VERSION

```
;
;   Quad-Print
;    (C) 1984
; by M. Beutjer
;
; This program dumps
; 4 hi-res screens
; side by side to
; produce one
; 640 x 400 printout.
;
;
        *=$C000
;
; DATA AREA
;
ORIG    .BYTE   0
DEST    .BYTE   0
CORIG   .BYTE   0
CDEST   .BYTE   0
LENGTH  .BYTE   0
NAME    *=*+16
PRNTLN  .BYTE   0,0,0,
           0,0,0,0,0
ROWCNT  .BYTE   0
COLCNT  .BYTE   0
FCSAVE  .BYTE   0
FBSAVE  .BYTE   0
REVRSE  .BYTE   0
TEMP    .BYTE   0
FLAG    .BYTE   0
;
; LABEL DEFINITIONS
;
SCREEN=$2000
SCRN1=$4000
SCRN2=$6000
SCRN3=$8000
SCRN4=$A000
CODES=$C1D0
POINTR=$FB
;
; KERNAL LABELS
;
CHKOUT=$FFC9
CHROUT=$FFD2
CLOSE=$FFC3
CLRCHN=$FFCC
OPEN=$FFC0
SETLFS=$FFBA
SETNAM=$FFBD
LOAD=$FFD5
CLALL=$FFE7
STOP=$FFE1
;
;   PROGRAM AREA
;
;
; TURN HIRES SCREEN
; ON OR OFF
DISPL   LDA     $D011
        EOR     #$20
        STA     $D011
        LDA     $D018
        EOR     #$08
        STA     $D018
        RTS
;
;       DUMP ROUTINE
;
;
; NEGATIVE ENTRY
REV     LDA     #255
        BNE     STORE
; NORMAL ENTRY
NOREVS  LDA     #0
STORE   STA     REVRSE
; OPEN 4,4,0
        LDA     #4
        LDX     #4
        LDY     #0
        JSR     SETLFS
        LDA     #0
        JSR     SETNAM
        JSR     OPEN
; DIRECT OUTPUT
; TO DEVICE 4
        LDX     #4
        JSR     CHKOUT
; POINT TO SCREEN 1
; AND 2
        LDA     #<SCRN1
        STA     POINTR
        LDA     #>SCRN1
        STA     POINTR+1
        LDA     #<SCRN2
        STA     FBSAVE
        LDA     #>SCRN2
        STA     FCSAVE
; SET PRINTER LINE
; SPACING
        LDX     #<SPCMLN
        JSR     PNTCMD
        JSR     CHROUT
; 25 ROWS PER SCREEN
        LDA     #25
        STA     ROWCNT
; PRINT 2 SCREENS!
        JSR     ROW
; POINT TO SCREEN 3
; AND 4
        LDA     #<SCRN3
        STA     POINTR
        LDA     #>SCRN3
        STA     POINTR+1
        LDA     #<SCRN4
        STA     FBSAVE
        LDA     #>SCRN4
        STA     FCSAVE
        LDA     #25
        STA     ROWCNT
; PRINT 2 MORE!
        JSR     ROW
; SEND PRINTER
; RESET CODE
QUIT    LDA     #27
        JSR     CHROUT
        LDA     #64
        JSR     CHROUT
        LDA     #4
; CLOSE CHANNEL
        JSR     CLOSE
```





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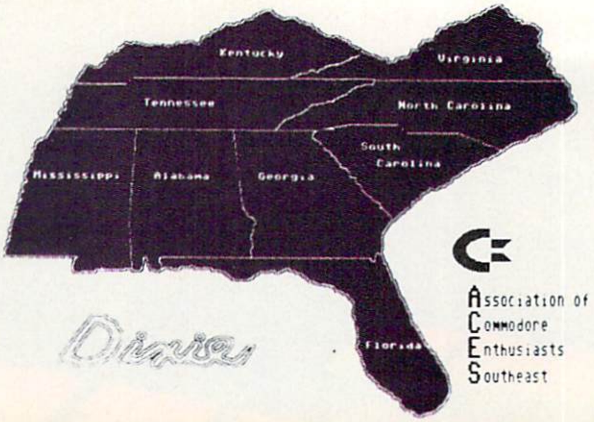
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Quad-Print dump on a Commodore 1526 printer.

You should also keep in mind the fact that the interface you use (for your Epson or Gemini printer) will affect the graphics operation. These programs assume that your printer does no translation of the data that is sent by the computer (transparent), and that the printer will do a linefeed automatically whenever it receives a carriage return.

For those of you using the 1526 version, I'm sure you will notice that your printer seems to do a lot of moving back and forth to print the pictures. Unfortunately, this seems to be unavoidable due to the way Commodore has set up the graphics for this printer. According to the manual, you may print one graphics character per line. The only way to print more than one graphics character per line is to send the printer a CHR$(141), or $8D hex, which is a "line reset" command. This command causes a carriage return without a linefeed, and that is why you see all the shaking. I don't think it will cause any problems, as I have dumped numerous pictures on mine. If there is a better way to do this, I haven't seen it. (But I would like to!)

Although hi-res screen design programs for the 64 are presently limited to one screen for the "sketch pad," this utility will allow you to do a lot of designs with your computer and printer that are not yet possible any other way. Good luck and happy doodling! □

SEE PROGRAM LISTINGS ON PAGE 95

```
         JSR    CLRCHN
         RTS
;
; DO 25 ROWS
; OF 80 COLUMNS
;
; SEND GRAPHICS
; SETUP COMMAND
ROW      LDX    #<LNCMLN
         JSR    PNTCMD
; SEND 40 COLUMNS
         JSR    DOCOL
; SAVE POINTER
         LDA    $FB
         PHA
         LDA    $FC
         PHA
; POINT TO
; SECOND SCREEN
         LDA    FBSAVE
         STA    $FB
         LDA    FCSAVE
         STA    $FC
; SEND 40 MORE COLS.
         JSR    DOCOL
; RESTORE SCREEN
; POINTERS
         LDA    $FB
         STA    FBSAVE
         LDA    $FC
         STA    FCSAVE
         PLA
         STA    $FC
         PLA
         STA    $FB
; CARRIAGE RETURN
         LDA    #13
         JSR    CHROUT
; CHECK STOP KEY
         JSR    STOP
         BNE    NOQUIT
         PLA
         PLA
         JMP    QUIT
; NEXT ROW
NOQUIT   DEC    ROWCNT
         BNE    ROW
         RTS
;
; PRINT 40 COLUMNS
;
DOCOL    LDA    #40
         STA    COLCNT

COLUMN   LDY    #0
ROTATE   LDX    #0
; TURN OFF BASIC ROM
         SEI
         LDA    #46
         STA    1
         LDA    (POINTR),Y
         STA    TEMP
; TURN ON BASIC ROM
         LDA    #47
         STA    1
         CLI
; SHIFT BITS
; INTO PRINT AREA
DOTS     ASL    TEMP
         ROL    PRNTLN,X
         INX
         CPX    #8
         BNE    DOTS
         INY
         CPY    #8
         BNE    ROTATE
; BUMP BIT MAP
; POINTER
         CLC
         LDA    POINTR
         ADC    #8
         STA    POINTR
         LDA    POINTR+1
         ADC    #0
         STA    POINTR+1
         LDX    #0
; SEND GRAPHICS
; TO PRINTER
PRINT    LDA    PRNTLN,X
         EOR    REVRSE
         JSR    CHROUT
         INX
         CPX    #8
         BNE    PRINT
         DEC    COLCNT
         BNE    COLUMN
         RTS
;
; LOAD A DOODLE
; FILE AND MOVE IT.
;
; OPEN 1,8,0
SCRNLD   LDA    #1
         LDX    #8
         LDY    #0
         JSR    SETLFS
; LOAD DOODLE

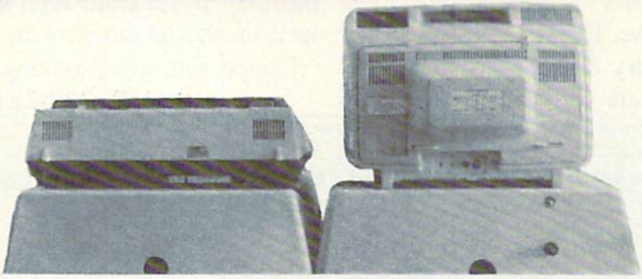
; AT 1C00
         LDA    LENGTH
         LDX    #<NAME
         LDY    #>NAME
         JSR    SETNAM
         LDA    #0
         TAX
         LDY    #$1C
         JSR    LOAD
         LDA    #1
         JSR    CLOSE
         JSR    CLRCHN
         RTS
;
; MOVE A DOODLE
; FILE FROM
; HI=ORIG LO=00
; TO: HI=DEST LO=00
;
         LDY    #0
         STY    $FB
         LDX    DEST
         STX    $FC
         STY    $FD
         LDX    ORIG
         STX    $FE
         STX    TEMP
M1       INC    TEMP
         INY
         CPY    #$20
         BNE    M1
         LDY    #0
MOVE     SEI
         LDA    #46
         STA    1
         LDA    ($FD),Y
         STA    ($FB),Y
         LDA    #47
         STA    1
         CLI
         INY
         BNE    MOVE
         INC    $FC
         INC    $FE
         LDA    $FE
         CMP    TEMP
         BNE    MOVE
         LDA    CDEST
         STA    $FC
         LDA    CORIG
         STA    $FE
         LDX    #4
         SEI

         LDA    #40
         STA    1
CMOVE    LDA    ($FD),Y
         STA    ($FB),Y
         INY
         BNE    CMOVE
         INC    $FC
         INC    $FE
         DEX
         BNE    CMOVE
         LDA    #47
         STA    1
         CLI
         RTS
PNTCMD   STX    PNTOUT+2
         STX    CMPARE+1
         LDY    #0
         LDX    #0
PNTOUT   INX
         LDA    LNCMLN,X
         JSR    CHROUT
         TXA
CMPARE   CMP    LNCMLN,Y
         BMI    PNTOUT
         RTS
;
;   EPSON PRINTER
;   CONTROL CODES
;
; LNCMLN IS
; LINE COMMAND LENGTH
; (NO. OF BYTES)
LNCMLN .BYTE  5
;
; LINDAT IS
; PRINTER SETUP
; COMMAND:
; ESC,*,6,128,2
LINDAT .BYTE
         27,42,6,128,2
;
         *=LNCMLN+10
; SPCMLN IS
; LENGTH OF
; LINE SPACING
; COMMAND
SPCMLN .BYTE  3
;
; SPCDAT IS
; PRINTER SPACING
; COMMAND: ESC,A,8
SPCDAT .BYTE  27,65,8
       .END
```

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Reader Service No. 276

SPEEDY

For the Unexpanded VIC 20

By Kevin Dewey

In this game you are Speedy, the fastest being in the universe—not an amazing accomplishment, seeing that no one else can move. Your goal is to collect all your smiley-faced green friends for a party you're throwing, while avoiding your frowning purple enemies, who are no fun at all, and in fact tend to make you explode upon contact with them. Yes, they are party poopers.

You get seven little Speedy clones to do this, and you gain another for every screen of friends you successfully clear. Speedy clones move very fast, and in all directions, so good reflexes and hand-eye coordination come in handy, but it's wise to also incorporate a bit of strategy into your gameplay. For instance, try to find the easiest ways to get a friend out from a group of enemies before plunging into the group. This, as well as other ways of using brain power instead of relying solely on a fast hand, will affect the outcome of the game for the better.

SCORING

The game is scored as follows. Every friend you pick up is worth seven points. Every *bonus token* is worth the number of the screen you are on, multiplied by the number of friends you have picked up thus far on that screen. For this reason, it is best to pick up a lot of your friends on a screen, and then pick up the bonus object when there are, say, one or two friends left, to maximize your score. The bonus objects are easy to spot, because they look unlike anything else.

At the end of the game, 50 bonus points are awarded for each screen you have successfully passed during the course of the game.

SKILL LEVELS

There are 15 skill levels, 1 being the easiest and 15 being the hardest. The main difference between the skill levels is in the amount of enemies. On screens like 15 there will be a great deal more purple faces than on the easier screens, but this can be looked at two ways. While it is harder to clear a screen of goodies when there are a lot of enemies around, the higher the skill level, the more the bonus token is worth, and the more points are possible. To get really high scores, you must learn to play well on the harder screens.

I hope you enjoy playing *Speedy*! □

SEE PROGRAM LISTING ON PAGE 108



THE **Short Wave Listener** FOR RECEPTION OF MORSE CODE & RADIO TELETYPE SIGNALS.

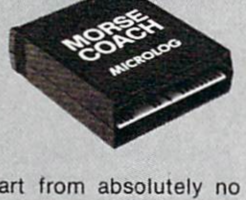
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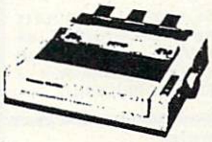
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* See Page 13

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For Commodore 64 and Vic 20 computers. Lets you use other printers with Centronics interfaces. This interface lets the printer act like a Commodore printer including printing the Commodore graphics (Dot matrix with graphic capability printers).
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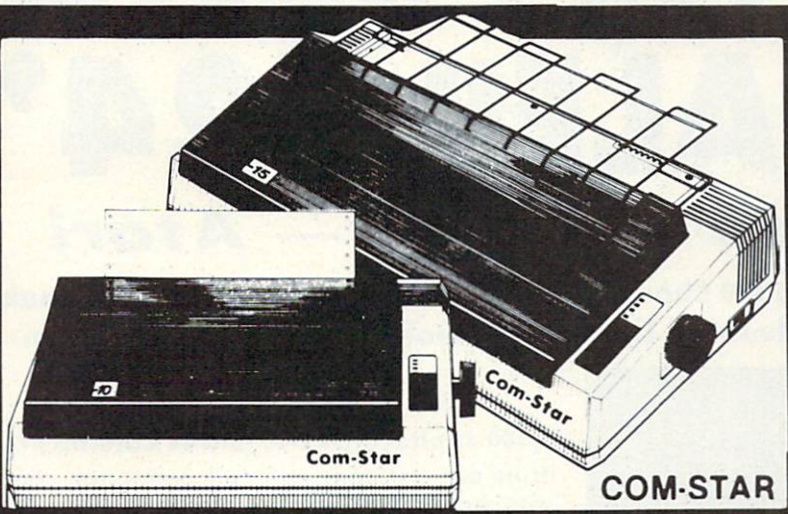
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10" carriage, prints 8½"x11" standard single sheet or continuous feed paper, Bi-directional, impact, dot matrix, 130-150 CPS, 9 x 9 dot matrix with double strike capability for 18 x 18 dot matrix (near letter quality), high resolution big image, underlining, back spacing, true lower descenders with super and subscripts, prints standard, italic, block graphics, and special characters. It gives you print quality and features found on printers costing twice as much!! (Centronics Parallel Interface) (Better than Epson FX80). List $499.00. **Sale $199.00.**

Premium Quality 150-170 CPS 15½X COM-STAR Business Printer $319.00

Has all the features of the 10X COM-STAR PRINTER plus 15½" carriage and more powerful electronics components to handle large ledger business forms! (Better than Epson FX 100). List $599. **Sale $319.00.**

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12" DAISY WHEEL PRINTER $199.00

"JUKI" Superb letter quality daisy wheel printer, 12" extra large carriage, up to 12CPS bi-directional printing, drop-in cassette ribbon, (90 day warranty) centronics parallel or RS232 serial port built in! (Specify). List $299.00. **Sale $199.00.**

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Printer/Typewriter Combination $279.00

"JUKI" Superb letter quality, daisy wheel printer/typewriter combination. Two machines in one — just a flick of the switch. 12" extra large carriage, typewriter keyboard, automatic margin control and relocate key drop in cassette ribbon! (90 day warranty) centronics parallel or RS232 serial port built in (Specify). List $399.00. ***Sale $279.00.***

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This is the world's finest daisy wheel printer. Fantastic letter quality, up to 20 CPS bi-directional, will handle 14.4" forms width! Has a 256 character print buffer, special print enhancements, built in tractor-feed (Centronics Parallel and RS232C Interface) (90 day warranty). List $649.00. **Sale $339.00**

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Better than IBM Selectric. Superb computer printer combined with the world's finest electronic typewriter. Two machines in one, just flick the switch for up to 20 CPS printing (**300 Words per minute**) on a 15" carriage that handles up to 14 1/8" in. paper. Drop in cassette ribbon — express lift off correction, Centronics parallel interface (90 day warranty). List $749.00. **Sale $439.00.**

• 15 Day Free Trial — 1 Year Immediate Replacement Warranty

PARALLEL INTERFACES

Atari — $59.00. For VIC-20 and COM-64 — $59.00. Apple — $79.00.

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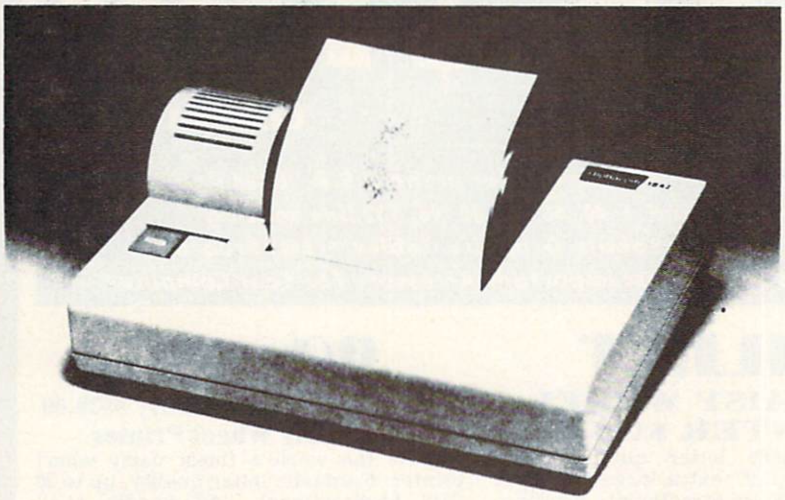
COM-STAR PLUS+ ABCDEFGHIJKLMNOPQRSTUVWXYZ
Print Example: ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

FANTASTIC PRINTER

$24.95 SALE!! $24.95

Commodore 64 — VIC 20 — Atari

☆ **40 And 80 Column Printers** ☆ **Up To 100 Characters Per Second** ☆ **Full Graphics Capability**
☆ **Upper And Lower Case** ☆ **Advanced Thermal Technology For Quiet Operation**



3100 Alphacom 42-80 CPS 40 Column Printer

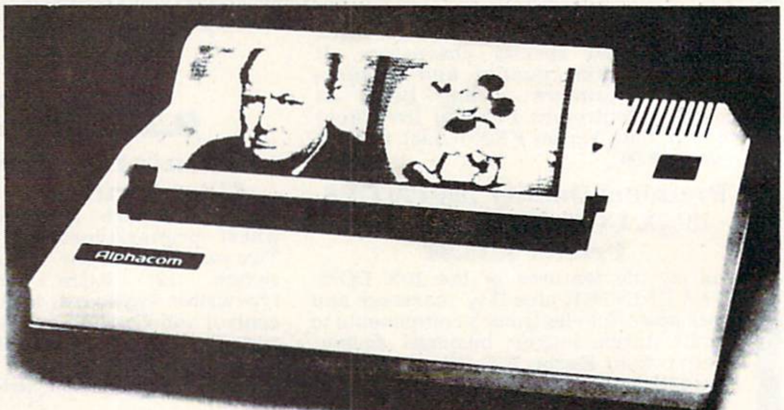
Print out listings with full computer character sets (interface required, see below). Print in upper and lower case. Comes with a roll of paper and all power adapters needed. Perfect for a spare printer or program lister. List $99.00. **Sale $24.95.**

40 Column Extra Paper	LIST	**SALE**
3103 25 Meter Rolls Blue	$9.95	**$3.00**
3104 40 Meter Rolls Blue	$16.95	**$3.95**
3105 25 Meter Rolls Black (1 per pkg.)	$12.95	**$3.95**
3106 25 Meter Rolls Blue (2 per pkg.)	$19.95	**$5.95**
3107 25 Meter Rolls Black (2 per pkg.)	$19.95	**$5.95**

3150 Alphacom 81-100 CPS 80 Column Printer

Now you can have a printer for the cost of a large box of paper. This printer prints in upper and lower case with true lower descenders. Comes with 1 roll of paper and power adapter. With the intelligent interfaces (sold below) you can do Ascii graphics as well as Atari or Commodore graphics. Plus you can do underlining and expanded modes. Print out pictures, program listings, word processing pages, etc. Perfect for the student or homeowner. List $199.00. **Sale $39.95.**

80 Column Extra Paper	LIST	**SALE**
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3154 40 Meter Rolls Black	$19.95	**$4.95**
3155 25 Meter Rolls Blue (2 per pkg.)	$19.95	**$7.95**
3156 25 Meter Rolls Black (2 per pkg.)	$19.95	**$8.95**



3101 Intelligent Commodore Interface — Allows you to hook the 40 or 80 column printer to the Commodore 64, do program listings, allows software screen dumps, etc. Includes Commodore graphics and reverse characters. (Specify 40 or 80 Column) List $59.95.
40 Column Sale $9.95. **80 Column Sale $14.95.**

3102 Intelligent Atari Interface — Allows you to hook the 40 or 80 column printer to the Atari computer, do program listings, allows software screen dumps, etc. Includes Atari graphics and reverse characters. (Specify 40 or 80 Column) List $59.95.
40 Column Sale $9.95. **80 Column Sale $14.95.**

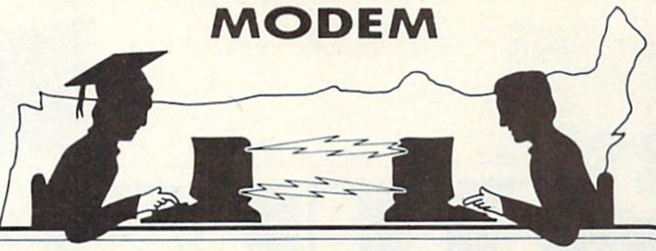
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Commodore 64
MODEM

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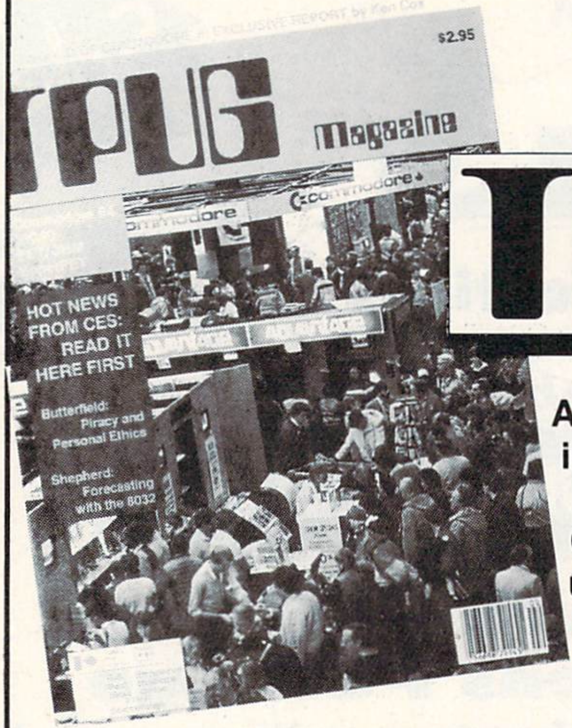
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REVIEWS

JUKI 6300
Juki Office Machine Corporation
$995

There is basically one word to describe the Juki 6300: professional. It has every feature that a daisy wheel printer should, and they all work flawlessly.

The 6300 prints at speeds up to 40 characters per second bidirectionally. It will vary the pitch from 10 to 12 to 15 characters per inch, or proportionally space text. Daisy wheels are readily available, for it uses the standard Diablo format. I found the print quality to be excellent. All characters were fully formed, and the alignment was perfect.

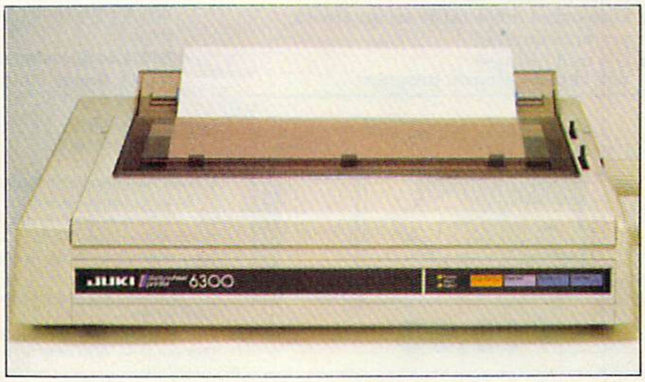
Printing effects are numerous. The 6300 will boldface, underscore, shadow print, subscript, and superscript. One unique feature is called high quality mode. Normally, the printer advances the ribbon a fraction of a space between characters. In high quality mode, the increment is one full space for each character printed. In addition to proportionally spacing text, the printer will auto-justify—add 1/120" spaces to the proportionally spaced text until the margins are reached.

Physically, the Juki 6300 is large. Measuring 22.4 x 15.8 x 4.7" and weighing almost 31 pounds, this printer is going to need some elbow room. The carriage is wide enough to accommodate paper up to 16" in width, making it ideal for most business forms. The paper feed is by friction only. A tractor would be useful, but I did not note any substantial paper slippage.

The 215-page manual includes virtually everything you need to know about the printer, unless, that is, you are a Commodore user. Operating instructions are provided for virtually all popular computers but Commodore's. Hopefully, this omission will be corrected soon.

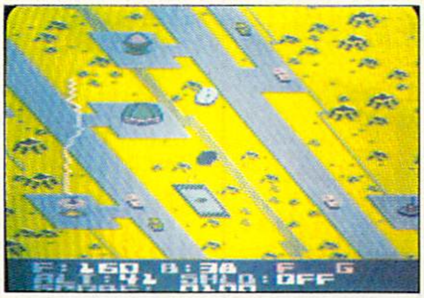
As stated earlier, this is a professional printer, and it has a professional price: $995. While this is inexpensive for a printer of its type (intended for small office use), it's a little steep for the average user. I would not recommend purchasing a 6300 to print an occasional letter, but if your interest is serious word processing or small business use, then it is an excellent choice.

The Juki 6300 daisy wheel printer offers auto-justification, numerous printing effects, and 40 cps speed. READER SERVICE NO. 238



Juki Office Machine Corporation, 299 Market Street, Saddle Brook, NJ 07662 (phone: 201-368-3666).

—David Barron



21st-century sequel to **Blue Max.**
READER SERVICE NO. 239

BLUE MAX 2001
Synapse Software
Commodore 64
Disk; $29.95

Bob Polin's *Blue Max* parlayed its brand of scrolling action combat into a slew of awards last year. Now the same author leaps from biplanes to futuristic hovercraft in this exciting sequel.

Blue Max 2001 puts the computerist into the flight suit of Max Chatsworth IX, a remote descendant of the heroic aviator of *Blue Max* fame. The implacable FURXX Empire has extended its tentacles to Earthbase Gamma IV. The game scenario begins just after the FURXX have conquered the planet and drained the lifeforce of the survivors to lengthen the lifespans of imperial bigwigs.

If the FURXX aren't stopped, their attack will spread to other colonies and eventually engulf Earth itself. The player must use the joystick to guide a single hovercraft in a desperate attack against the alien invaders.

The flying ship is equipped with two super weapons capable of breaching the FURXX defense system. The gravonic penetrator, fired by pressing the action button while pointing the stick in the desired cardinal direction, can strafe ground installations or knock aircraft out of the sky. The hovercraft also carries 40 gravonic annihilator bombs which it can drop on buildings, bridges, and vehicles.

Two special targets merit the highest priority. The diamond-shaped Shield Enhancer increases the hovercraft's defensive capabilities. The Terrain Sequencer, a disk with a rotating core, allows the lone attacker to advance to the next alien hoverfield.

Once the hovercraft takes off from its field, the gamer pushes the stick up and to the left to start the terrain scrolling diagonally down the screen. The scrolling can be stopped by moving the stick down and to the right.

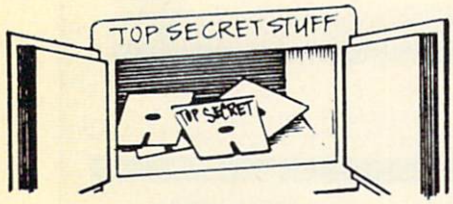
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Slik Load is a Kartridge for the C-64.
Slik Load is the most reliable, effective and thought out Kartridge of it's kind.
The options include:

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- **Old and un-new Will restore a basic program**
- **Status key will give you information on device number, bytes free and status of the drive.**
- **Silk Load is also fully compatible with the 1541 Super Rom**



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DMS-Errors 20, 21, 22, 23, 27 & 29 Format Single Tracks Read Disk Errors
½ Track Reader-read and select ½ track
½ Track Formatter-Format a disk with ½ tracks. This is where the next protection schemes are coming from.
Drive Mon-Disk Drive assembler/dis-assembler. For your 1541.
The Doc-Disk Doctor that reads code under errors.
Sync Maker-Place a sync mark on **any** track out to 41. Also used for protection.
Sync Reader-Check for Sync bits on **any** track out to 41.
Change Drive No.-Changes drive number (7-30).
Disk Logger-Finds starting track sector; start and end addresses.
Disk Match-Compare any two diskettes. Byte for byte.
New Wedge-Easier to use DOS wedge.
ID Check-Check ID's on **any** track.
Unscratch-Restore a scratched file.
View-BAM-Visual display of the free and used sectors on a diskette.
Read/Write Test-1541 performance test.
Repair a Track-Repair a track with checksum errors. Reads code under errors and restores track.
Fast Format-Format a disk in just 10 seconds (with verify!).

This is the only utility of its kind. It even has a 3 min. copy on it.

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4-**Hardcopy of Numbers** will print out list of numbers where a computer answered.
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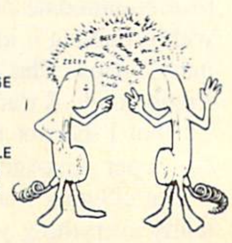
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7-CYCLE MESSAGES
8-READ SYSOP MESSAGES
9—WRITE OPENING MESSAGE
10-READ LOG
11-CYCLE LOG
12-READ DOWNLOAD FILE
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15-CREATE OTHER SYSTEMS



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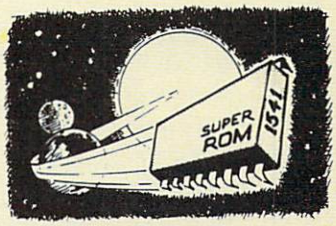
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D-Compiler $59.95

The first D-Compiler to give you back your source code *after* your program has been compiled with **Blitz.*

*Blitz is a trademark of Skyles Electric Works

1541 Super ROM $39.95



- *Fast Save Load Verify*
- *Fast Scratch and Validate*
- *10 Second Format with Verify*
- *No more Drive Head rattling during Format or Error Reading*

also Save with Replace is Improved

- *Two times faster, Eight times faster when used with Turbo 64 which is included*
- *1541 Super ROM is 100% Compatible*
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APALLO Does it All. This program is the latest generation of copy programs. It will do everything the $39.00 and $49.00 programs will do and **more.** It Copies **ALL** drive errors, bad tracks and sectors, non-standard format, bad syncs, and half tracks. We feel this is the best program of its kind available...

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- *View Directory*

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Sure Copy *will put all errors automatically on disk: 20, 21, 22, 23, 27 and 29's.*

D-CODER

- Translates any machine language program into easy-to-read English descriptions with complete explanations of each command!
- Makes complete notations of all important memory locations accessed by the program! (SID, VIC, MOS, KERNAL, etc.)
- Gives you three ways of accessing programs:
  1) **Will read and list programs from DISK**
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- Can be used to locate and examine any machine language program's protection routines!
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- Printer option for complete hard copy listings!

You no longer need to be an EGGHEAD to read Machine Language.



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N-CODER $19.95

the machine language manipulator...



The perfect companion program to D-CODER!

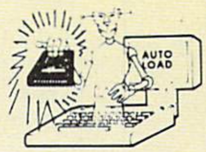
Allows you to easily make changes in machine language programs... right on the disk!

- *Rewrite ability allows code to be altered and then rewritten directly to the disk!*
- *Features sector-by-sector scrolling assembly language display of machine language programs!*
- *Notation of ASCII text equibalents for easy spotting of embedded text strings!*
- *Handy reference display of all assembly language commands and their ML numerical equivelents!*
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- Works with more drive
- Takes up no memory
- Reset switch included



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This Disk has over 100 routines, some of them are routines for protection, smooth scrooling, modem routines, and sound and color routines. They can easily be incorporated into all of your programs. It is also fully documented. **$19.95**

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The publisher cannot assume responsibility for errors in the above listing.

Rebels have established secret strongholds on the surface of Gamma IV. When the ship lands at a field, it can take on fuel, resupply its bombs racks, and repair damage caused by alien aircraft and flak guns.

The joystick steers the ship in any desired direction and changes altitude. Though the hovercraft can drop bombs from any height, it must get fairly close to the ground before its gravonic penetrator can wreak havoc.

The control panel located directly below the main display monitors the hovercraft status. This includes altitude, fuel supply, accumulated damage to specific ship systems, number of bombs remaining, and current score. Changes in the color of the playfield border provide an additional visual indicator of the current altitude range. For example, a gray border informs the pilot that the hovercraft is at the proper height to strafe the ground.

Better documentation would have improved this otherwise excellent program. In particular, labeled illustrations of each of the major play-features would have greatly speeded up the learning process.

Blue Max 2001 doesn't introduce any startling design concepts, but it fulfills the essential requirements of a good sequel. It extends and refines the elements which made the original game popular, while it introduces enough new challenges to generate fresh excitement.

Synapse Software, 5221 Central Avenue, Richmond, CA 94804 (phone: 415-527-7751). *—Arnie Katz*

PLUSWRITER PRINTER
Alphacom, Inc.
$399.00

Priced at $399, the Alphacom Pluswriter is yet another addition to the vast array of low-cost letter quality printers available today.

Housed in a sleek black and grey plastic case, the Pluswriter interfaces easily to the Commodore. Alphacom uses an interesting method of interfacing: an intelligent interface cartridge plugs into a slot on the back of the printer. The cartridge is different for every computer, and provides the hardware/software link to make it function properly for your situation. I experienced no problems listing programs or using word processors. In fact, the Pluswriter emulates the Diablo 630 printer, which makes it compatible with just about everything.

When printing, the Pluswriter cruises at a moderate 18cps bidrectionally; painful for printing out your science fiction trilogy, but for most applications well within reason. The print quality is good, except for those occasions when characters will move slightly up, down, left, or right, and appear a bit disoriented. I didn't like the Courier 10 printwheel included with the printer so I purchased a more attractive daisy wheel. I was pleased to learn that either Qume or Diablo daisy wheels will work, and can be found most anywhere (I found mine at a local stationery store for $7.50). Ribbons are also easy to find, for the Pluswriter uses Diablo Hy-Type II. I also found these locally for $4.95.

Since the Alphacom emulates the Diablo 630 many special effects are possible including boldface, shadow printing, subscripts, and superscripts. These all work well and are all easily accessible.

The only major problem I had with the Pluswriter was the tendency of continuous tractor paper to move across the platen. This required constant realignment and was very annoying. With single sheets I had no difficulties.

The Alphacom Pluswriter is a competitive addition to the low priced daisy wheel printer market that should satisfy the needs of most home computer users.

Alphacom, Inc., 2323 South Bascom Avenue, Campbell, CA 95008 (phone: 408-559-8000).

—David Barron

CALC NOW!
Cardco, Inc.
Commodore 64
Disk; $39.95

Computer industry pundits like to attribute the very existence of the personal computer to a spreadsheet pro-

An open letter to the readers of Ahoy Magazine Vincent Kurek President: The Ennon Corporation

My purpose in writing is to ask you to join me in shaping the future of the new and most unusual field in computer technology today: Artificial Intelligence.

This incredible power and spectacular creative potential are available to you, for your computer right now. However, there is an alarming possibility that such amazing technology which you have every right to, may not be available to you other that through this offer.

This is unfortunate but somewhat understandable due to the way technology is created. You see, only the business oriented corporation can finance research. It therefore is in a position to dictate immediate research goals. These goals are increasing profits through more efficient production. While valid, they are merely creative and do absolutely nothing to foster exploration in new applications. The result: technology is never used to its fullest potential. But what's worst of all is that these competitve corporations have absolutely no desire to share technology with each other, let alone with you. So, they don't. As a result, the infinitesimal amount of technology that finally trickles down to you is:

A. So expensive you are prohibited from procurring it
B. Shamefully inferior to the real thing

remember...you can buy high-tech consumer goods, but never the technology that creates it.

This same situation confronts you in the new Artificial Intelligence field, but with a difference: There is no true Artificial Intelligence for the home computer user! The few programs claiming to be Artificial Intelligence are really simulators. They are not the real thing. Possessing a mere token of the power and versatility, simulators are clearly not worth their expensive price.

I have tried repeatedly to convince my colleagues that it is in their best interest to release genuine Artificial Intelligence to the general public. The refinement, modification and adaptation as individuals create new applications would improve Artificial Intelligence tremendously. This would benefit everyone in the long run.

I have met with little success. Apparently, it seems that immediate corporate profit is more important than sharing technology with the public. Therefore, the Ennon Corporation stands alone in offering superior Artificial Intelligence programming directly to the home computer enthusiast.

Announcing AN-83: The "Thinking" Program

Believe me when I say AN-83 is the real thing. It is a true "thinking" program that receives an initial "knowledge base" from a data file read when AN-83 is started. Using inductive and deductive logical analysis, this amazing program deduces everything from that data and adds it to its memory. Conversing with you, AN-83 adds and combines with facts already known. It generates new conclusions not explicitly contained in its original knowledge base—just like your own thinking process! The result: it knows considerably more than the specific facts given to it.

AN-83 can also think about anything. It is virtually unlimited in its application. Think of your possibilities. The potential is limitless. In the right hands, AN-83 would revolutionize the adventure, strategy and other smart game-playing programs to say nothing of classic arcade games. On the other hand, AN-83 could be one of the most powerful business analysts available to the home computer.

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In addition, you will be receiving free, Eliza—the most amazing conversational A.I. program to date. Run this for your friends and jaws will drop with amazement. Eliza's responses are so human, it's uncanny. An entertaining program, Eliza will answer once and for all the question: What can your computer do?

How to Learn Artificial Intelligence

You can be creative. Experiment and modify to fit your personal use because AN-83 and Eliza both possess source code in basic, the most popular easy to use language for the micro. Their extensive, easy to understand commands walk you through the source code step by step. It's surprisingly simple. Even the beginner can understand the "How and Why of A.I."

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The real profit to Ennon Corporation will be your participation in the future of Artificial Intelligence. Therefore, I am pleased to say nobody will miss this chance because they could not afford it. AN-83 is priced to cover just a fraction of its research and developmental costs.

The "Thinking" Program AN-83 is just $21.57. What's more, the astounding Eliza is yours absolutely free.

I guess it's obvious that I want you to participate in the future of Artificial Intelligence. Forgive my excitement and enthusiasm but I just know you are going to be very happy and impressed that such things could be done with your computer. You just won't believe it. Please take this opportunity now. Simply fill out your coupon below and mail today. Don't miss out. It's such a wonderful future of discovery and excitement that awaits you.

With very best of wishes,

Vincent Kurek

Vincent Kurek

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The Alphacom Pluswriter (see review on page 66) cruises at a moderate 18cps. The printer emulates the Diablo 630, so many special effects are possible.
READER SERVICE NO. 265

gram. That first spreadsheet program was *Visicalc,* which through its symbiotic relationship with the Apple introduced thousands of burned-out *Pong* players to the really useful aspects of computing.

Today, more spreadsheet programs exist than you can shake a ledger at. Regardless, the market is always on the lookout for a better, cheaper program. Depending on your exact needs, *Calc Now!* from Cardco may be exactly that.

Cardco began its product line with hardware add-ons like its numeric keypad. More recently, it has expanded into software with programs like *Write Now!,* a wordprocessor with a mail merge feature, and *Graph Now.* Cardco's latest release, *Calc Now!*, is compatible with all three. For the $39.95 price, you get most of the features of spreadsheet programs costing much more.

Calc Now! is a single load program —no disk-swapping needed. Once it's loaded, *Calc Now!* runs much like other spreadsheets. For details on the basic operations of spreadsheet programs, pull out your May 1984 issue of *Ahoy!* and reread Terry Silveria's comprehensive review and evaluations of ten competing products. To compare *Calc Now!* to those programs, here's the information for Terry's chart of spreadsheet features:

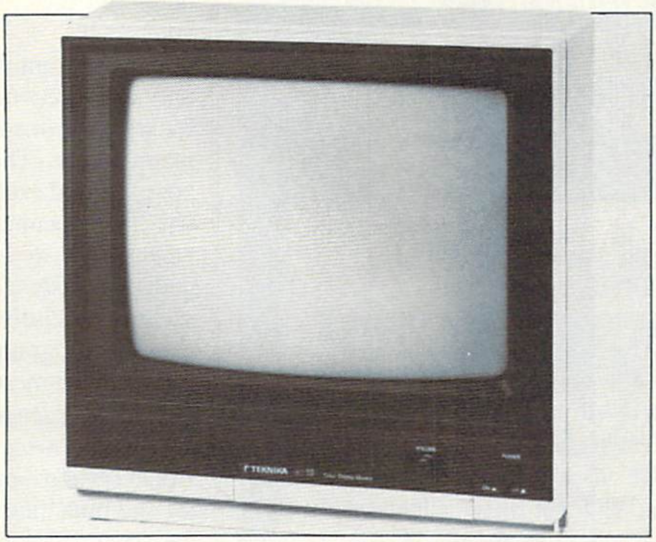
Relative Copy	Yes
If Then Command	Yes
Row/Column Insert	Yes (and row/column delete)
Rejustify Cell Contents	Yes (either left or right)
Split Screen	Yes (either vertical or horizontal, synchronized or unsynchronized
Adjustable Column Width	Yes (from 3 to 36)
Logic Operators	Yes (And, Or, Not)
Fix Titles	Yes (lock the top row(s) or the left column(s) or both in place)
Graph	Yes (print rows of asterisks to represent values)
Sort	Yes (alphabetical or numerical on any column)
Search	No
Link	No
Maximum Column Width	36
Maximum # Columns	64
Maximum # Cells	1600 (with an 8-digit number in each
Maximum # Rows	254
Price	$39.95

Calc Now! uses the top (status) lines of the screen to show you the cell number, type, justification, contents, and format. Available formats are dollar, floating point, integer, graph (*), logical (true/false), and set number of decimal places. The status lines also tell you whether recalculation will occur automatically or must be triggered and how much memory is left for your data. After the program is loaded, 39K is available. If you build spreadsheets that are larger than this, you may need to consider one of the other programs that can link spreadsheets by allowing you to reference one spreadsheet in another.

Several functions are available in *Calc Now!* that work on ranges of cells. SUM will total the contents of a range of cells; AVERAGE will average them; MIN will find the smallest; MAX the largest; and COUNT will return the number of non-blank cells. Two other powerful and more unusual functions also work on ranges. GET will evaluate a formula, count down that number of cells, and return the value in the cell it finds. FIND will evaluate an expression, search through a range of cells until it finds a value which is lower, and return the value in the next cell. Linked with the sort feature, FIND gives you a very sophisticated spreadsheet tool.

Here are some one-liners on features I especially like. Sorting rows based on the contents of any column (or part of a column) is fast; only a couple of seconds even for a big spreadsheet. Existing cell formulas can be edited—you don't have to retype a long formula which has an error near the end. Whenever you need to reference another cell in a formula, you can, after pressing the British pound sign key, point (with the cursor) to the cell you want and automatically enter its number, a necessary feature for multiscreen spreadsheets. You can command *Calc Now!* to move the cursor up, down, left, or right when you hit return—handy when you change from entering columns of numbers to entering rows.

More? Okay. Instead of printing all or part of your spreadsheet, you can choose to print all of its formulas for



The Teknika MJ-10 color monitor, like the 1702, accepts separate luminance and chrominance inputs. Its chief weakness: an undersized speaker that does not reproduce sound very well. ***READER SERVICE NO. 266***

verification. (If you've ever made a mistake with pencil and paper, wait until you see what havoc you can create with a spreadsheet.) Individual cells can be protected, a handy feature for spreadsheets used infrequently or by someone else. Without exiting from *Calc Now!* you can initialize a disk, get a directory, delete or rename files, and specify disk and printer device numbers.

That's a lot of features, but is *Calc Now!* hard to use? No, if you're at all familiar with spreadsheets, it's a snap. Even if you're not, keyboard templates describe the uses of function and other command keys. Forgetful? Hit the help key followed by any command key you are unsure of. In an onscreen window, a description of that key's function will appear. The program I reviewed had only an 11-page temporary manual, so I cannot say what the documentation will look like. But Cardco does provide technical support by phone.

My favorite, and final, help feature is something we all demand of ourselves in programs we write, but which is not available from spreadsheet programs. A non-printing comment or documentation can follow the contents of any cell; just start it with a semicolon. If you have ever tried to decipher one of your old spreadsheets, much less someone else's, you'll know how valuable this can be.

Cardco, Inc., 300 S. Topeka, Wichita, KS 67202 (phone: 316-267-6525). *–Richard Herring*

MJ-10 MONITOR
Teknika Electronics Corporation
$279.95

When the carton containing the Teknika MJ-10 appeared on my desk one morning for review, I thought I would be taking a look at just another monitor. I was wrong. The MJ-10 produces a surprisingly good picture, easily the equal of the Commodore 1702's. This is partially due to the fact that the MJ-10, like the 1702, accepts separate luminance and chrominance inputs. This helps achieve a level of clarity and color rendition not possible with monitors boasting only composite video inputs.

On the front of the monitor are an exposed power switch, power light, and volume control. Hidden behind a flip-out panel are controls for horizontal position, vertical position, contrast, brightness, color, and tint. Other controls–vertical linearity, vertical size, horizontal hold, and input level–are on the back.

My only complaint with the MJ-10 has nothing to do with the video, but rather the audio. Its speaker is undersized and does not reproduce sound very well. Additionally, a larger amplifier and an earphone jack would have been useful.

All in all, the MJ-10 is an excellent choice in a monitor if the highest possible picture quality is a must.

Teknika Electronics Corporation, 353 Route 46 West, Fairfield, NJ 07006 (phone: 201-575-0380).

–David Barron

MUSICWARE
SONG BUILDER
SONG EDITOR
SONG PRINTER
SOUND MAKER
Sequential Circuits
Commodore 64
Disk; $39.95 each

I was immediately impressed with the *MusicMate* keyboard from Sequential Circuits. Its 32 keys have nice action, and the lightweight and sturdy construction make it ideal for creating music on the C-64. I was less than overwhelmed, though, by the supplied driver software, the *#970 MusicMate Musicware.* It's your basic meat-and-potatoes program, devoid of any gravy. While it does what it was designed to do–demonstrate the capabilities of the keyboard by allowing you to try several different sounds, store your creations in RAM, and play them back–no provisions are included for saving your songs to disk, recording individual voices, creating new sounds, editing, or printing out your compositions. Clearly, the MusicMate keyboard would be much more valuable to computer musicians if it had software that was commensurate with its own capabilities.

To fill this need, Sequential has released the *MusicWare* line. They've taken the modular approach, whereby dedicated software modules have specific functions, and you only buy the particular utilities you need when you need them.

The *MusicWare* line consists of four additions to the software that comes with the keyboard: *#971 Song Builder, #972 Song Editor, #973 Song Printer, and #974 Sound Maker.* The module names provide you with a good description of the functions. Let's take a look at each individually, as well as interactively.

#971 SONG BUILDER

Song Builder is the music composition module. It allows you to enter your melodies, one voice at a time, and record them on disk. You're given a selection of stock sounds that simulate a wide variety of musical instruments. A metronome feature



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Reader Service No. 252

helps you keep time while recording your tracks.

The program is menu-driven, and only eight keys on the C-64 are used for selection or advancing through the menu items. The MusicMate keyboard is used exclusively for note entry. The documentation booklet is written in a well-illustrated, easy to understand style. Additionally, help screens concisely explain how to access the program's functions.

One of the most impressive aspects of *Song Builder* is its sequencing capability, allowing you to create individual sections, or sequences, of music and treat them as individual entities. After recording your sequences, you can link them in any desired order, or even change the key and tempo of different sequences. This lets you create whole songs of any length quickly by treating individual song sections as sequences. Let's say that your song contains these components: verse 1, verse 2, chorus, verse 3, chorus, chorus. To create a complete song, you need only record one verse and one chorus, then assemble them in the right order, since the music for the verses and choruses is the same each time they recur. What would Beethoven have thought of such a work saver? He would have loved it, I'm sure!

#972 SONG EDITOR

The *Song Editor* module provides you with the editing capability to do minor touchups on your songs or major rewrites on given measures. The documentation explains how to access its many features, and the program contains multiple help screens. As with the other *MusicWare* modules, *Song Editor* is entirely menu driven and very easy to use, requiring only eight of the C-64's keys for implementing functions. All note entry is handled through the MusicMate keyboard.

Possibly the most outstanding feature of *Song Editor* is that it automatically calculates the effects of your editing changes and compensates for them. If you alter the pitch or duration value of any note in the composition, *Song Editor* automatically

takes care of the rests! To change any note on the display, strike the correct note on the MusicMate keyboard and it will appear instantly on the staff. You can even change the time signatures or transpose the key with this program.

Another big plus is the ability to step through your music one note at a time, or view your score one measure at a time. The video display is in traditional grand-staff format, with signatures, notes, and rests looking exactly as they should.

Song Editor is a tremendously powerful music editing program that picks up where *Builder* leaves off and carries you further down the musical path.

#973 SONG PRINTER

If you have need of printed musical scores in standard notation, *Song Printer* will allow you to print out sheet music of your songs, and even give you the options of which voices to print. Consistent with the other products in the *MusicWare* line, it is menu-driven and easy to use. The program is accompanied by excellent documentation, and help screens are included.

Song Printer will work with the Commodore 1525, 801, or other compatible dot matrix printers suitably interfaced. Because the music symbols and graphics must be created, letter-quality or daisy wheel printers won't work.

In addition to printing out excellent quality music scores, *Song Printer* allows you to choose the melody line(s) to be printed. This is particularly useful for learning harmony parts in vocal arrangements, whereby the soprano, alto, and tenor may each have a score with their particular parts on it. The piano accompanist, however, may utilize a score showing all three parts. This is a great print option to have, and *Song Printer* is, to my knowledge, the only music printing program that allows this sort of flexibility.

#974 SOUND MAKER

Your C-64's SID chip is capable of creating some awesome sounds, and the *Sound Maker* module makes such sonic tailoring easy. The program disk contains twenty musical instrument sounds and sound effects which you may alter to your heart's content. Included are several help screens that explain the functions of the control settings; additionally, the documentation expands on this information.

Sound Maker also provides you with a novel video display while creating sounds. Unlike music synthesis programs which rely on bar or numeric setting displays, you get a simulated analog control display that depicts knobs for adjusting sound qualities. This feature really imparts the feel of a traditional electronic music synthesizer to the program. Another nice wrinkle is the ability to select different octaves for the sound, in addition to "tweaking" the bass, treble, or a combination of the two.

You can try out your sounds as you create them by using the MusicMate keyboard with the program. And when you've created one you particularly like, you can store it on diskette for use with other programs in the *MusicWare* line.

SUMMARY

All the *MusicWare* modules reflect a lot of thought on the part of their designers. They're very easy to use; even for the computer music novice, they perform flawlessly, and they are all interactively compatible. The modular software approach allows you to purchase specific-capability features as your needs dictate, and combining these *MusicWare* modules produces a full-featured music package that's hard to beat.

Sequential Circuits, Inc., 3051 North First Street, San Jose, CA 95134 (phone: 408-946-5240).

—Tom Benford

PROMAL

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Commodore 64
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Reader Service No. 254

PROMAL makes a compromise between the loose syntax of BASIC and the intense structure of LISP-type languages. PROMAL is procedure-oriented, which means that programs are written in little modules, each of which performs a specific task. All of the small units of code are then called by a main procedure (program), in a structure which resembles BASIC "GOSUB-RETURN"-called subroutines.

There are two types of modules in PROMAL: procedures and functions. When called, functions return a value (data or a Boolean). Procedures are series of program commands, which return no value. Within a module, local variables may be defined. In fact, modules may even be defined recursively with up to 256 levels of nesting. All modules may be sent arguments (data) on which to perform operations. The data structures in PROMAL are similar to those in BASIC, with the exception of Boolean data.

Boolean data are the values TRUE and FALSE which may be assigned to a variable or be returned as the result of the evaluation of an expression. One example of an expression which returns a Boolean when evaluated is the CMPSTR function. CMPSTR compares two strings in relationship to an operator (<,<=,<>,=,>=,>). If the relationship is true (e.g. A<B), the CMPSTR returns TRUE, else FALSE.

PROMAL also has a very different way of treating command words. All programs, including the main program and all modules, are given names and told what arguments are needed for proper operation when initially defined. To execute a program, only the use of the name and inclusion of argument values are necessary. In a way, definition of a module is the same as creating a new command. It is even possible to create a whole range of sound and color commands, avoiding the annoyance of POKEing all those values into memory.

However, in terms of syntax of individual statements, PROMAL and BASIC vary by very little. The basic assignment primative is the = operator (a primitive is an element of a computer language which is originally written in machine language, as opposed to modules—written in PROMAL). The conditional constructs are IF-ELSE, IF-THEN, and CHOOSE. The looping constructs are WHILE, REPEAT-UNTIL, and FOR.

The most interesting and useful new primative is the ESCAPE-REFUGE construct. When an error occurs in a module called by another module, it is often desirable to return to the original module and restore all variables to their original state. Using REFUGE, it is possible to define three places and states to which the program may return and "recover" from a disaster. Each REFUGE is given a number from one to three. When an ESCAPE command is executed, the refuge number is specified and all state variables are restored at the location corresponding to the appropriate refuge.

PROMAL statements, unlike those in BASIC, have no line numbers, may only occupy one line, and must have spaces between keywords and variables. However, these small inconveniences are more than compensated for by the fact that PROMAL is a compiled language. There are two fundamental types of languages, interpreted and compiled. BASIC is interpreted. Interpreted languages are evaluated sequentially, as individual lines are executed. This is understandably slow. Compiled languages are evaluated into machine language in one large translation effort and stored in machine language form in an object file, on disk. Then, when the object file is executed, it is as if the program was originally written in machine language. However, the usual problem which arises with compiled languages is that the original program must be written into a document file, through a separate word processing program. PROMAL fully supports creation of document source files by supplying a built-in editor. An EXECUTIVE (operating system) is also included, completing the PROMAL environment.

As an introduction to structured programming languages and as an alternative to BASIC, PROMAL is well worth the time needed to learn it and the $49.95 to purchase it. Systems Management Associates deserves a round of applause for greatly extending the computing powers of the Commodore 64.

Systems Management Associates, 3700 Computer Drive, P.O. Box 20025, Raleigh, NC 27619 (phone: 919-787-7703). *—Rachel Schleimer*

ERRATUM

On page 107 of our April '85 issue, we listed incorrect last byte information for the *BASIC Trace* program. The correct last byte is C1FA. To enter it, load your version of *Trace* (,8,1), then load and run *Flankspeed*. Enter first and (correct) last byte, hit f5, and continue from address C1F8. After typing in the last line, save the program.

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SCREEN DUMPING ON THE COMMODORE 64

GETTING SCREEN BIT GRAPHICS TO YOUR PRINTER WITH HELP FROM MACHINE LANGUAGE

BY ROGER S. MACOMBER
PROFESSOR OF CHEMISTRY
UNIVERSITY OF CINCINNATI

Sooner or later every programmer with an interest in computer graphics will tap the versatility of bit mapped graphics. The program described here will serve not only as a primer on the creation of screen bit graphics, but will also allow reproduction of the screen image on your printer. In addition, if you study the program (see page 107) carefully you will learn something about memory management on the Commodore 64, as well as experiencing the dramatic effect of machine language on the speed of execution of the program.

The program requires an 8-pin dot matrix printer with bit graphics capability. It was written for use on either a Gemini 10 or 10X, using a standard Centronics serial to parallel interface; use with other 8-bit graphics printers will require some modification.

SCREEN BIT GRAPHICS

First, let's examine how bit graphics are generated on the monitor screen. Each standard screen character comprises an 8 dot by 8 dot (64 pixel) array. If we multiply this by 40 characters per row and 25 rows, we note there are 64,000 total pixels (320 across by 200 down), each of which can be separately activated to form the screen image. Because each pixel is turned on or off by a 1 or 0 (a single bit) in the appropriate character memory location, the most direct approach is to manipulate 8 pixels at a time as one byte of memory.

The basic idea behind creation of a screen image is depicted in Figure 1 (see page 74). By examining the "zeroth" byte of character memory (hereafter referred to as the bit map), we see that pixel number 1 is controlled by bit 7, pixel 2 by bit 6, etc. Thus, for any of the possible numbers from 0 to 255 which may be stored in a byte, we generate a different pattern of activated pixels. The entire screen will require 8000 bytes, arranged as shown in Figure 2 (see page 74).

Let's examine version I of the program through line 180. In order to allow for later expansion of the BASIC program without overwriting screen memory, you should carry out the POKEs described in line 1. This moves the beginning of the BASIC program to memory location 16384 ($4000). Next (line 20) we select an 8K block of memory beginning at location 8192 ($2000) for the bit map. The POKE tells the VIC-II chip where to find the bit map and screen memory. Line 25 activates the screen bit mode. Line 30 clears the 8000 bytes of the bit map, a process that takes over a minute in BASIC. As we will see later, it is nearly instantaneous in assembly language. Line 40

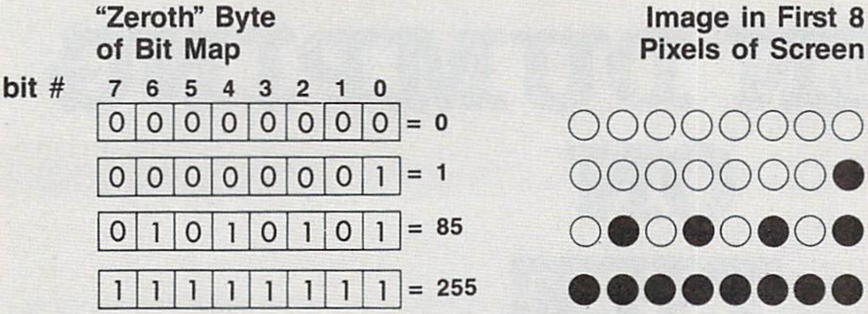


Figure 1

The correspondence between the bit map and its screen image. ○ and ● represent deactivated and activated pixels, respectively. The bit image to the right results from the four different values stored in the corresponding single byte on the left.

stores in screen memory what colors will be used for activated and deactivated pixels. The upper 4 bits of each byte control the color of activated pixels in the corresponding character, the lower 4 bits control the color of the deactivated pixel (0 = black, 1 = white, 2 = red, etc.). Thus, a 1 (00000001) results in a white background and black dots. Changing the 1 to 16 (00010000) produces the reverse. Lines 100-180 actually create the screen bit map. As an example I have chosen an exponentially damped cosine wave. Recalling that our screen image is 320 pixels wide and 200 pixels high, we generate a set of X, Y points which describe the function in lines 100 and 105. (Y = 0, X = 0 corresponds to the upper-left-most pixel.) Lines 150 through 165 determine which byte of the bit map (Figure 2) will contain the data for each point, while line 170 determines which bit of the byte should be activated. For example, consider the point X = 6, Y = 8 (shaded pixel in Figure 2). This corresponds to LINE 0 of CHARAC-

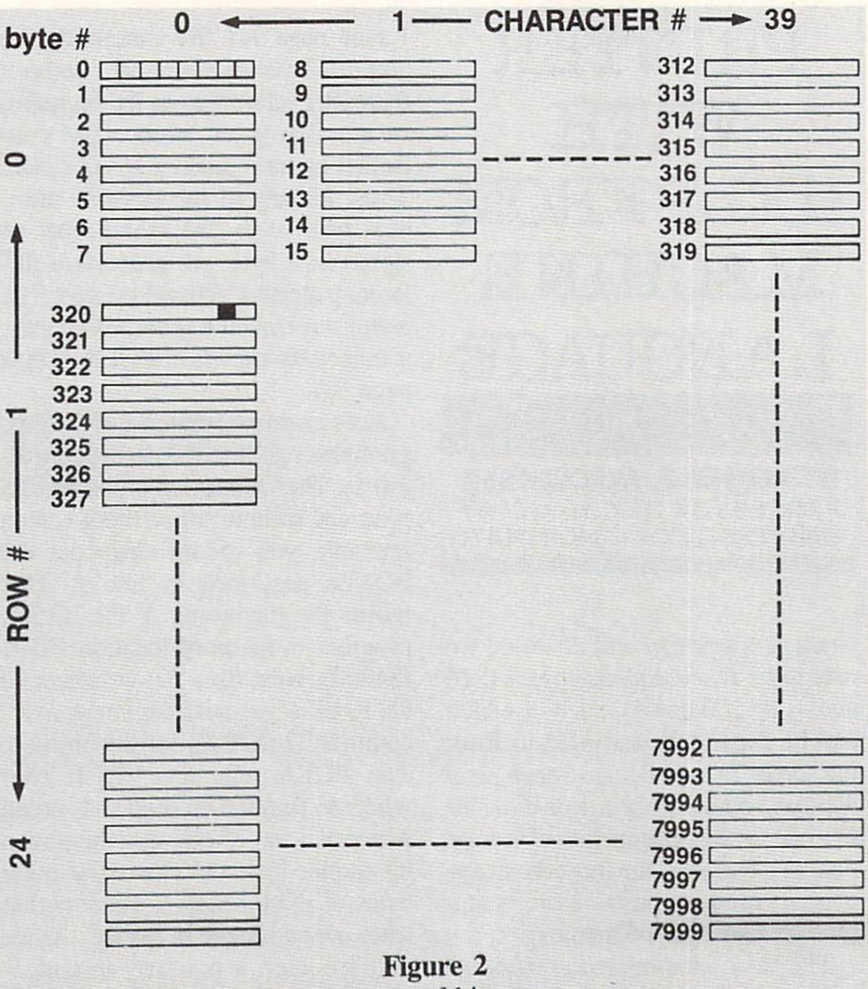


Figure 2

The arrangement of bit map memory.

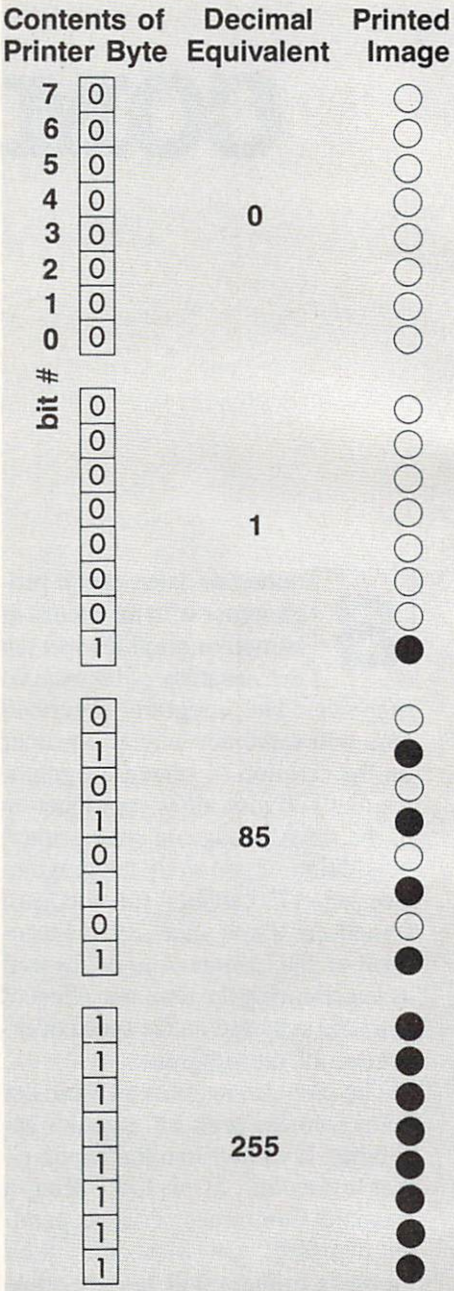


Figure 3

The correspondence of printer bit map to printed image. ○ and ● represent blanks and printed dots, respectively. (This is the order for the Gemini and Epson series of printers; the C-Itoh printers reverse the bit order.)

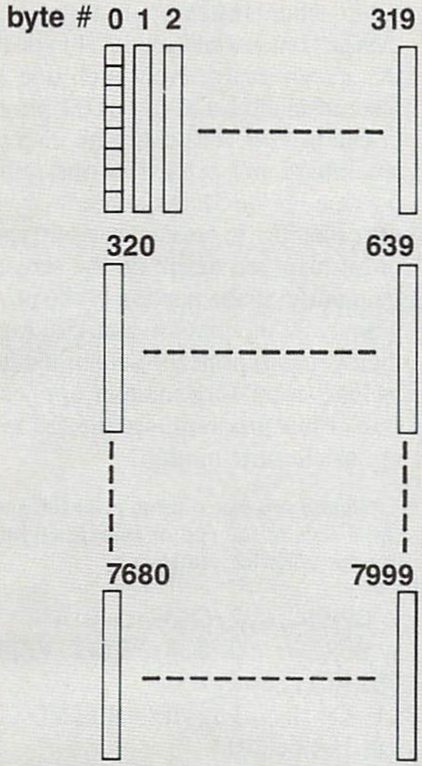


Figure 4
The arrangement of bit map memory for the printer.

TER 0 in ROW 1. Since there are 320 bytes per row (see Figure 2), and 8 bytes per character, the location of the appropriate byte is 8192 + 1*320 + 0*8 + 0 = 8512. Line 170 determines that bit 1 (seven over from the left; see Figure 1) will receive the "1". Line 175 makes the appropriate POKE, and the point appears on the screen. Line 180 sends us back to calculate the next point, and this continues until the X domain has been exhausted.

BIT GRAPHICS ON YOUR PRINTER

Your Gemini 10X (with interface in transparent mode) can be used to create printed pictures in a manner quite analogous to screen bit graphics. The main difference is in the way the bit map is accessed by the printer. The printer prints one row at a time with the height of each row determined by the number of pins in the print head. An 8-pin print head can print any combination of zero to 8 dots (vertically aligned), as shown in Figure 3. Comparison of this with Figure 1 shows that the bit map for a printer must be arranged differently (Figure 4) than the screen bit map (Figure 2). If you are doing printed bit graphics directly, you can plan your memory setup to correspond to Figure 4. The problem we have, however, is to take a screen image stored as in Figure 2, and make it accessible, bit by bit, as shown in Figure 4. Thus, to create the "zeroth" printer byte, we need the 7th *bit* of each of the first 8 *bytes* of the screen bit map, each multiplied by the appropriate power of 2. Printer byte 1 comes from the 6th *bit* of each of the first 8 *bytes* of the bit map, and so on.

Now let's look at the rest of version 1. Line 190 starts the printing sequence when you depress the f1 key on the Commodore keyboard. Lines 205 and 210 activate the printer and set the linefeed length to 16/144".

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Lines 215 and 220 draw a horizontal border, indented one inch. The actual printing takes place in a loop of instructions 225-270. For each printed row (8 dots high) the high resolution bit mode is activated (225), then a one inch margin is created, marked with a " I " [CHR$(245) in 230]. Next, in a series of nested loops (lines 235-265), an entire row is assembled and printed byte by byte from the screen bit map. To discover how this section works, I recommend setting up a sample "character" (8 horizontally stacked bytes of the screen bit map) and carry through the process by hand to create the corresponding 8 sequential vertical bytes of the printer bit map. Note also that each byte is printed twice (line 255) to improve clarity. At the end of the row another " I " is printed (line 265) and we return to assemble the next row. After the 25th row (L = 24) we draw another indented horizontal line (line 275, 280), and finally close up shop.

Now that you understand how it works, save it and run it. Don't forget the preliminary POKEs! Right before your eyes you will see the bit map zeroed (about 70 seconds), the field turned white (all pixels are deactivated, remember?), and black dots describing the function beginning to appear. After the screen has filled (about 2 minutes), press f1. Now the wait begins, because each printed line requires over 2 minutes to be assembled, making the entire plot an hour-long process! The final printed result is shown in Figure 5.

A LITTLE HELP FROM ASSEMBLY LANGUAGE

It would certain be preferable to have the image printed in a matter of seconds rather than hours. Fortunately, this can be readily accomplished using machine language for the time-consuming loops (lines 230 through 265) as well as the task of clearing the bit map (line 30) and setting colors (line 40). Using the technique of appending machine code at the end of our BASIC program, we now generate version II of the program as follows:

1) delete lines 20-40, and 225-265 from version I

2) add lines 5, 30, 195, 200, 225, 230 and 265 of version II

3) by PEEKing in 45 (40) and 46 (67), we note the location of the end of the BASIC program is at 17192. Now, POKE 45, 250 to extend the memory allocation by 210 bytes, more than enough to accommodate the machine code.

4) add the following instruction:

```
10 FORI=0 TO 206:INPUTB%:P
OKES1+I,B%:NEXT:STOP
```

5) run the program, and enter the 207 bytes of machine code, one by one, as listed at the end of version II. Do it slowly and carefully!*

6) delete line 10

Now save version II, and run it. Notice anything different? First, the bit map is cleared and the screen turns white instantly. But the big change comes when you hit f1 to print the screen image. Now each line is assembled almost as fast as the printer can print it. The entire bit map is assembled and printed in one minute (see Figure 5)! So, you now have the capability to create whatever type of bit map you desire on the screen by modifying the portion of the program between lines 100 and 150. And then you can print the screen image as hard copy. (For another application of this program, see the follow-up article next month.)

***Should you ever want to print the machine code at the end of your program, use the following sequence:**

```
7 OPEN4,4,2:CMD4:J=0
9 FORI=0 TO 206:PRINT PEEK
(S1+I);:J=J+1
11 IF J > 15 THEN PRINT CH
R$(10);:J=0
13 NEXT:PRINT#4,:CLOSE4:ST
OP
```

A WORD ABOUT THE MACHINE CODE

If you're interested in how the machine code does its job, disassembling the program and studying the assembly language is recommended. The first 31 lines accomplish the clearing of the bit map and setting screen color. Note that locations 251 ($FB) and 252 ($FC) are used as zero page indirect addresses to the bit map.

The assembling of lines for the printer is more complicated, and begins in line 32. Again locations 251 and 252 are used as indirect pointers for the section of memory being assembled (see line 195 in version II). Also, a table of powers of 2 is stored in 2048-2055 ($0800-$0807); see line 200 of version II. A step-by-step analysis of this program, though beyond the scope of this paper, would show that it accomplishes all the same things as lines 230-265 in the original version, but the machine code executes over 100 times faster! For those starting their foray into machine language programming, I recommend this as an instructive example. □

SEE PROGRAM LISTING ON PAGE 107

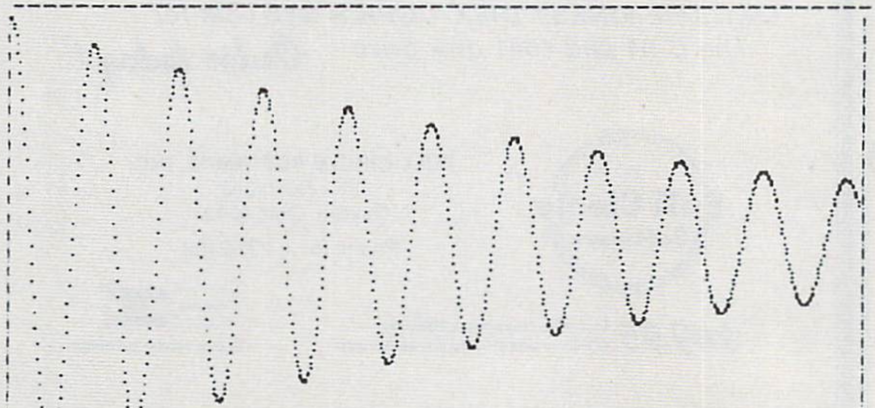


Figure 5
The final printed output from both versions of the program.

UNDER THE HOOD

An Inside Look At Your Commodore's Microprocessor

By Mark Andrews

Every computer can be divided into three main parts: a memory (often subdivided into RAM and ROM), input and output devices (such as keyboards, video monitors, cassette recorders, and disk drives), and a *central processing unit,* or CPU.

In a microcomputer such as the Commodore 64, all the functions of a CPU are contained in a microprocessor unit (sometimes abbreviated MPU). And your Commodore's MPU is a very large scale integrated circuit (VLSI) called the 6510. In this column, we're going to peek inside the 6510 chip and see what makes it go.

The 6510 microprocessor, an improved version of the 6502 chip used in Apple and Atari computers, contains seven main parts: an arithmetic-logical unit (ALU) and six addressable registers.

The ALU is one of the most important components of the 6510 chip. Every time the 6510 performs a calculation or a logical operation, the ALU is where all the work is done.

The ALU can actually perform only two kinds of calculations: addition and subtraction. Division and multiplication problems can also be solved by the ALU, but only in sequences of addition and subtraction operations.

The ALU can compare values, too–but only by subtracting one value from the other. By performing a subtraction operation, the ALU can determine whether one number is larger than the other, or the two numbers are the same.

When two numbers are to be added, subtracted, or compared, both are fed into the ALU, along with a simple three-letter instruction called a mnemonic. When the requested calculation has been performed, its result is left in a special 6510 register called an *accumulator.* Once a value is stored in the 6510's accumulator, it can be moved into any other 6510 register, or any register in your Commodore's memory.

Now we'll look at how the ALU and the accumulator in the 6510 chip work together. Suppose you wanted your computer to add 2 and 2, then place the result into a certain memory register. You could use an assembly language routine like this:

```
LDA #02
ADC #02
STA $FB
```

The first instruction in this routine, "LDA", means "load the accumulator" (with the value that follows). In this case, that value is 2. The "#" sign that is in front of the 2 means that the 2 is to be interpreted as a literal number, rather than as the address of a memory location in your computer.

The second instruction in the routine, "ADC", means "add with carry." In this addition problem, there is no number to be carried, so the "carry" part of the instruction has no effect here, and all the ADC instruction does is add 2 and 2.

The third and last instruction in our routine, "STA", means "store the contents of the accumulator" (in the memory address that follows).

As you can see, the memory address that follows the instruction "STA" is $FB–the hexadecimal equivalent of the decimal number 251.

Since there is no "#" sign in front of the hex number $FB, your assembler will not interpret $FB as a literal number. Instead, $FB will be interpreted as a memory address–and your Commodore will store the sum of 2 and 2 in Memory Register $FB.

(Incidentally, if you did want your assembler to interpret $FB as a literal number, you would have to write it "#$FB." When both a "#" symbol and a dollar sign appear before a number, it is interpreted as a literal hexadecimal number.)

If the third line of our routine read "STA #$FB", however, that would be a syntax error–because "STA" (store the contents of the accumulator in...) is an instruction that must be followed by a value that can be interpreted as a memory address, not by a literal number.

Besides the accumulator, the 6510 processor has five other registers: the X Register, the Y Register, the Program Counter, the Stack Pointer, and the Processor Status Register. Here is a brief summation of the functions of each:

• The *X Register* (abbreviated "X") is an 8-bit register often used for temporary storage of data during a pro-

gram. But it has a special feature: it can be incremented and decremented with a pair of one-byte assembly language instructions (INX and DEX). It is therefore often used as an index register, or counter, during loops and read/data-type instructions in programs.

• The *Y Register* (abbreviated "Y") is also an 8-bit register, and can also be incremented and decremented with a pair of one-byte instructions (INY and DEY). So, like the X Register, it is used both for data storage and as a counter.

• The *Program Counter* (abbreviated "PC") is a pair of 8-bit registers used together as one 16-bit register. The two 8-bit registers are sometimes referred to as "Program Counter-Low (PCL)" and "Program Counter-High (PCH)."

The program counter always contains the 16-bit memory address of the next instruction to be executed by the 6510 processor. When that instruction has been carried out, the address of the next instruction is loaded into the program counter.

• The *Stack Pointer* (abbreviated "S" or "SP") is an 8-bit register that always contains the address of the top element in a block of RAM, called the hardware stack (usually called simply "the stack"). This is a segment of memory in which data is often stored temporarily during the execution of a program. We'll go into more detail about how the stack works later on.

• The *Processor Status Register* (usually called just the "status register," but abbreviated "P") is an 8-bit register that keeps track of the results of operations performed by the 6510 processor.

THE PROCESSOR STATUS REGISTER

The processor status register is different from the other registers in the 6510 microprocessor. It isn't used for storing ordinary 8-bit numbers, as the others are. Instead, it uses its bits as flags to keep track of several kinds of important information.

Four of the status register's bits are called status flags: the carry flag (C), the overflow flag (V), the negative flag (N), and the zero flag (Z). These are used to keep track of the results of operations being carried out by the other registers inside the 6510 processor.

Three of the P register's other bits, called condition flags, are used to determine whether certain conditions exist in a program. These three bits are the interrupt disable flag (I), the break flag (B), and the decimal mode flag (D).

An eighth bit in the status register is not used.

THE PROCESSOR STATUS FLAG

The processor status register can be visualized as a rectangular box containing six square compartments. Each "compartment" in the box is actually a bit, and each bit is used as a flag.

If a given bit is a "1" instead of a "0," it is said to be a flag that is set.

If a given bit is a "0" instead of a "1," it is said to be a flag that is cleared.

The bits in the 6510 status register—like the bits in all 8-bit registers—are customarily numbered from 0 to 7. The rightmost bit is Bit 0, the leftmost is Bit 7.

THE PROCESSOR STATUS REGISTER

BITS	7	6	5	4	3	2	1	0
FLAGS	N	V	–	B	D	I	Z	C

Following is a complete list of the flags in the 6510's processor status register, and an explanation of each.

Bit 0—The Carry Flag (C): As you'll recall from last month, it isn't easy to do 16-bit arithmetic with an 8-bit chip like the 6510. When the 6510 chip is required to perform an addition operation on a number greater than 255—or if the result of a calculation might be greater than 255—a program has to be written that will break each number down into 8-bit segments for processing, and will then patch all of the numbers back together.

This kind of mathematical cutting and pasting involves a lot of carrying (during addition) and borrowing (during subtraction). And the carry flag of the 6510 P register is the flag that keeps up with all of this carrying and borrowing. If an addition operation results in a carry, the carry flag is automatically set; if a subtraction operation requires a borrow, the carry flag notes that, too.

Since the carry flag is almost constantly being set and cleared as a result of carries and borrows in addition and subtraction, it's a good idea to clear it before an addition operation is to be carried out—and to *set* it before a *subtraction* operation takes place. Otherwise, your calculations may be messed up by the leftover results of previous operations.

The assembly language instruction that clears the P register's carry bit is CLC, which stands for "clear carry." The instruction that sets the carry bit is SEC, which stands for "set carry."

Bit 1—The Zero Flag (Z): When the result of an arithmetical or logical operation is zero, the status register's zero flag is automatically set. Addition, subtraction, and logical operations can all result in changes in the status of the zero flag. If a memory location or an index register is decremented to zero, that will also result in a set zero flag.

An ironic 6510 convention is that when the result of an operation is zero, the zero flag is *set* to 1, and when the result of an operation is not zero, the zero flag is *cleared* to 0. It's important to understand this concept, since it would be easy to assume that the zero flag operates in the opposite manner.

There are no assembly language instructions to clear or set the zero flag. It's strictly a "read" bit, so instructions to write to it are not provided.

Bit 2—The Interrupt Disable Flag (I): Some Commodore programs contain interrupts—instructions that halt operations temporarily so that other operations can take place. Some of these are called maskable interrupts because you can prevent them from taking place by in-

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cluding "masking" instructions in a program. Others are called nonmaskable because you can't stop them from taking place, no matter what you do.

You can disable a maskable interrupt with the P register's interrupt disable flag. When it is set, maskable interrupts are not permitted; when it is clear, they are.

The assembly language instruction to clear the interrupt flag is CLI. The instruction to set the interrupt flag is SEI.

Bit 3–The Decimal Mode Flag (D): The 6510 processor normally operates in binary mode, using standard binary numbers of the type discussed last month. But the 6510 can also operate in what is known as a binary-coded decimal (or BCD) mode. To put the 6510 into BCD mode, you have to set the decimal flag of the 6510 status register.

BCD arithmetic is slower than plain binary arithmetic, and it consumes more memory. But its results, unlike those of plain binary arithmetic, are always 100% accurate. So it is often used in programs in which accuracy is more important than speed or memory efficiency.

The assembly language instruction that clears the decimal flag is CLD. The instruction that sets the flag is SED.

Bit 4–The Break Flag (B): The break flag is set by a special assembly language instruction, BRK. Programmers often use the break instruction while debugging. When the instruction is used and the break flag is set, certain error-flagging operations take place and control of the computer returns to the programmer.

Bit 5–Unused: For some reason, the microprogrammers who designed the 6510 status register left one bit unused. This is the one.

Bit 6–The Overflow Flag (V): The overflow flag is used to detect an overflow from Bit 6 (the next-to-leftmost bit) in a binary number. If you don't know what that means yet, don't be concerned. The overflow flag is used primarily in advanced 6510 arithmetic–specifically, to keep track of changes in the plus and minus signs of signed numbers when signed binary arithmetic is being performed. As a beginning- or intermediate-level Commodore assembly language programmer, you'll rarely–if ever–have occasion to use the overflow flag. Nevertheless, we'll discuss it at length in a later column.

The assembly language instruction that clears the overflow flag is CLV. There is no instruction to set the flag, since it's read-only.

Bit 7–The Negative Flag (N): The negative flag is set when the result of an operation is negative, and cleared when the result is zero. It is often used in operations involving signed numbers, and has other uses that will be discussed in later columns. There are no instructions to set or clear the negative flag; there is no need for any, since the flag is used for test purposes only.

PROGRAM: THE 6510 SIMULATOR

To give you a closeup look at what happens inside your computer when it runs an assembly language program, I've created a BASIC program called the *6510 Simulator* (see page 98). It is not a machine language assembler, but it works much like one. When you load it and run it, it will present you with a screen display that will show you exactly what happens inside your 6510 chip's X, Y, and P registers when your computer is running an assembly language program.

To use the *6510 Simulator*, all you have to do is type in legal statements written in assembly language. You can use it with any of the instructions mentioned in this column, and with all other instructions that are legal in 6502/6510 assembly language. The simulator will not accept labels or indirect addressing modes (two more topics that will be discussed in later columns). It will also reject statements that contain incorrect spacing, syntax errors, illegal address modes, and unacceptably long numbers. And, although it can read memory locations, it can't write to them. So it can't freeze up your computer while you're testing out a program.

The *6510 Simulator* is a rather long and complex program, but well worth the time it will take to type it. If an assembly language routine won't work correctly, the *6510 Simulator* will often show you exactly what's going wrong. So please type it and save it (or purchase this month's *Ahoy!* disk or cassette). By the time we get to later columns in this series, you'll be glad you did. □

SEE PROGRAM LISTING ON PAGE 98



Reader Service No. 249

COMMODARES

PROGRAMMING CHALLENGES

By Dale Rupert

Each month, we'll present several challenges designed to stimulate your synapses and toggle the bits in your cerebral random access memory. We invite you to send your solutions to:

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We will print the most interesting and/or unusual solutions. Be sure to identify the *name* and *number* of the problems you are solving. Also show sample runs if possible, where appropriate. Programs on diskettes are welcome, but they must be accompanied by listings. Also tell what makes your solutions unique or interesting, if they are. You must enclose a stamped, self-addressed envelope if you want any of your materials returned.

Your original programming problems, suggestions, and ideas are equally welcome! The best ones will become *Commodares.*

Problem #18-1: Cycling Function

Jim Speers (Niles, MI) suggested this problem. Complete the function definition in line 10 so that the output in line 30 will cycle from 0 to 100 and back again in steps of 5. Perhaps a little head scratching is in order.

```
10 DEF FNC(D)=...
20 D=5 : X=0
30 PRINT X : X=X+D : D=FNC(D) : GOTO 30
```

Jim sent some general purpose cycling functions which we will reveal next month.

Problem #18-2: Billiard Balls

Wallace Leeker (Lemay, MO) has sent his solution to the classic billiard ball problem. A warning before you start on this one: it's addictive and time consuming. Here it is:

You have twelve billiard balls, all identical in appearance. One has an internal flaw, making it either heavier or lighter than the other eleven. The computer has a simple balance scale and is allowed only three weighings in order to determine which is the flawed ball.

The user will decide which of the balls, numbered 1 through 12, is the culprit. The computer will select a combination of balls to put onto the balance (some on the left side and some on the right). The user will then tell the computer whether the scale is a) heavy on the left, b) balanced, or c) heavy on the right. The computer will repeat this sequence two more times. After the user's third response, the computer will tell which ball is different and whether it is heavy or light.

If some of you end up dreaming about billiard balls, don't say we didn't warn you.

Problem #18-3: Scroll Ski

Use the Commodore's screen scrolling to create a downhill skiing game. One simple catch: your program must be only one or two lines long. As easy as that!

Problem #18-4: Letter Math

Here's one of millions of similar problems. Perhaps you've solved them with paper and pencil before. This time you can be lazy and let the computer do all the work. Write a program to let the computer find values of X, Y, and Z to make this sum correct. Except for FOR and NEXT statements, use only one statement per program line. By the way, Z must not be 0.

```
XYZ
 ZY
  X
---
YXX
```

This month we will look at reader's solutions to February's *Commodares* as well as a few odds and ends. First I want to reiterate the time schedule for this column. This June issue is being written in mid-February. All letters received by the middle of the magazine cover month will be given prime consideration for publication. Responses to February *Commodares* received after the middle of February will still be read, but they have less probability of being mentioned since they are too late to be discussed this month. Don't let that discourage you from sending your solutions any time. The most unusual ones will be included in this column. If you sent a valid solution to some of the *Commodares* but your name didn't appear in genuine print, it is probably because your solution didn't reach us before mid-month.

In response to *Commodare #10-1: Numeric Palindrome* from last October, James Killman (Memphis, TN) mentioned that he ran his program for 28 days, 12 hours, 28 minutes, and 46 seconds before he got fed up and

quit—without a solution! His program cycled through 12,954 passes and reached a number 5,366 digits long. The problem was to take a number (196), reverse it, add the two together, see if the sum is a palindrome, and if not repeat the process using the sum instead of the original number. The palindrome for 196 has supposedly not been determined even on large computers. Mr. Killman's routine POKEs each digit into a reserved section of memory, reversing the direction each time. It POKEs, compares, reverses the digits, and then adds them. The numbers can be as large as the amount of memory allows. If you would like to see a listing of Mr. Killman's twenty line BASIC program, send a stamped, self-addressed envelope to *Commodares* with your request.

Rick Nash (Millersburg, OH) sent the following assembly language implementation of *Commodare #13-3: Micro Calc.* As we mentioned last month, the solution to this problem doesn't really do anything that isn't already available in BASIC. The user can easily type in a string of numbers and mathematical operators in command mode and let the computer print the results. Writing a program to let the user type the numbers and operators gives some insight into the problems of parsing and of how a compiler might be created. Rick's solution shows some useful procedures for accessing various BASIC utility routines from assembly language. The assembly language listing and a BASIC program to run it are listed below:

```
1 REM ASSEMBLY LANGUAGE USR ROUTINE
2 REM SOLUTION TO PROBLEM #13-3
3 REM                 MICRO CALC
4 REM BY RICK NASH
5 REM
90 :*=$02A7       ;PROGRAM ORIGIN
100 :TXTPTR=$7A
110 :INDEX =$22
120 :FRESPC=$35
130 :VARPTR=$64
140 :BUFFER=$0200
150 :CHRGET=$0073
160 :MOVSTR=$B68C  (VIC=$D68C)
170 :CRUNCH=$A57C  (VIC=$C57C)
180 :FRMEVL=$AD9E  (VIC=$CD9E)
190 REM SAVE TEXT POINTER ON STACK
200 :LDA TXTPTR
210 :PHA
220 :LDA TXTPTR+1
230 :PHA
240 REM (64) PTS. TO STRING DESCRIPTOR
250 :LDY #0
260 :LDA (VARPTR),Y     ;STRING LENGTH
270 :PHA                ;ON STACK
280 :INY
290 :LDA (VARPTR),Y     ;ADDRESS LOW
300 :STA INDEX
310 :INY
320 :LDA (VARPTR),Y     ;ADDRESS HIGH
330 :STA INDEX+1
340 :PLA                     ;STRING LENGTH
350 :TAY                     ;TO Y
360 :LDA #0
370 :STA BUFFER,Y            ;SET END
380 :LDA #<BUFFER
390 :LDX #>BUFFER
400 :STA FRESPC              ;SET PTRS FOR
410 :STX FRESPC+1            ;VARIABLE MOVE
420 :STA TXTPTR              ;SET PTRS FOR
430 :STX TXTPTR+1            ;CRUNCH ROUTINE
440 :TYA                     ;.A=VAR LENGTH
450 REM MOVE VARIABLE TO INPUT BUFFER
460 :JSR MOVSTR
470 REM TOKENIZE STRING
480 :JSR CRUNCH
490 REM BUMP TEXT POINTER
500 :JSR CHRGET
510 REM EVALUATE EXPRESSION
520 :JSR FRMEVL
530 REM RESTORE TEXT POINTER
540 :PLA
550 :STA TXTPTR+1
560 :PLA
570 :STA TXTPTR
580 REM RETURN TO USR ROUTINE & ASSIGN
590 REM VALUE IN FAC1 TO FLOATING
600 REM POINT VARIABLE
610 :RTS
```

```
1 REM BASIC SOLUTION TO PROBLEM #13-3
2 REM MICRO CALC
3 REM BY RICK NASH
4 REM
40 FORA=679 TO 738:READ D:POKE A,D:NEXT
50 POKE 785,167:POKE 786,2
60 INPUT"PROBLEM ";A$:IF A$="END" THEN E
ND
70 PRINT"THE ANSWER IS: ";USR(A$):PRINT:
GOTO 60
80 DATA 165,122,72,165,123
90 DATA 72,160,0,177,100
100 DATA 72,200,177,100,133
110 DATA 34,200,177,100,133
120 DATA 35,104,168,169,0
130 DATA 153,0,2,169,0
140 DATA 162,2,133,53,134
150 DATA 54,133,122,134,123
160 DATA 152,32,140,182,32
170 DATA 124,165,32,115,0
180 DATA 32,158,173,104,133
190 DATA 123,104,133,122,96
```

The BASIC program installs the machine language routine, then asks the user to enter a numeric problem such as 2-3*SQR(18), which is stored as a string. You may use any BASIC functions, previously defined floating point or integer variables, or mathematical or Boolean

operators in the numeric problem. In the machine language program, the sequence is as follows: 1) the string (A$) is copied into the input buffer ($0200), 2) the string is scanned and tokenized, 3) the formula is evaluated using BASIC's evaluator routine with the result left in the floating point accumulator, and 4) the USR routine returns the value from the floating point accumulator (FAC1)

Below is the solution from R.W. Kober (Buffalo, TX) to his *Commodare #17-2: Printer Sentinel* from last month:

```
1 REM  R.W. KOBER
2 REM  PROBLEM #17-2 : PRINTER SENTINEL
5 GOTO 100
10 OPEN 4,4
20 PRINT#4:IF ST AND 128 THEN 40
30 CLOSE 4:RETURN
40 PRINT TAB(248)"THE PRINTER IS NOT ON!
"CHR$(19):GOTO 20
99 REM ---MAIN PROGRAM---
100 PRINT CHR$(147)
110 GOSUB 10 :REM <<< CHECK ON PRINTER
120 OPEN 4,4:PRINT#4,"PRINTER IS ON"
130 CLOSE 4
```

Before printing, the program calls this subroutine. If the printer is not on, the message is printed, and the subroutine loops until the printer is turned on. If the printer is on, control is returned immediately to the calling program. Notice the use of the ST (STATUS) function. Also notice that the space between the ST and the AND is necessary. Can you figure out why? Omit the space and see what happens.

John Twardowski (Albany, NY) sent solutions *Commodares #14-1: Maximus Input* and *#14-2: Singles Only* combined into one program.

```
1 REM JOHN TWARDOWSKI
2 REM PROBLEMS 14-1 AND 14-2
3 REM MAXIMUS INPUT AND SINGLES ONLY
4 REM
10 PRINT CHR$(147) : LF$=CHR$(157)
20 PRINT CHR$(164);
30 GET A$:IF A$="" THEN 30
40 IF A$=CHR$(13) THEN PRINT LF$" " : GO
TO 70
50 IF A$=CHR$(20) THEN PRINT LF$" "LF$LF
$;:B$=LEFT$(B$,LEN(B$)-1):GOTO 20
60 B$=B$+A$:PRINT LF$A$;:GOTO 20
70 DIM A(90):FOR K=1 TO LEN(B$):B=ASC(MI
D$(B$,K,1)):A(B)=A(B)+1:NEXT
80 PRINT:PRINT"MISSING":FOR K=65 TO 90:I
F A(K)=0 THEN PRINT CHR$(K)" ";
90 NEXT:PRINT:PRINT"DUPLICATES":FOR K=65
 TO 90:IF A(K)>1 THEN PRINT CHR$(K)" ";
100 NEXT
```

Several other readers took a similar approach to creating a cursor in *Problem #14-1.* There was no requirement that the cursor must blink. The majority of the solutions to *Problem #14-2* were much like John's approach.

Paul Sisul (St. Louis, MO) sent the following solution to *Problem #14-2: Singles Only* which doesn't use any IF statements. Instead he uses logical expressions. Furthermore, his solution contains no arrays or subscripted variables.

```
1 REM PAUL SISUL
2 REM PROBLEM #14-2 : SINGLES ONLY
3 REM
20 INPUT S$:FOR J=65 TO 90:C=0:FOR K=1 T
O LEN(S$):C=C-(MID$(S$,K,1)=CHR$(J))
30 NEXT K:PRINT CHR$(48*(1+(C=1))+C);" "
;CHR$(J*-(C<>1)),:NEXT J
```

To understand Paul's solution, recall that a logical expression has a value of 0 if it is false and −1 if it is true. Consequently the function CHR$(J * −(C< >1)) represents CHR$(0) for any letter whose count is equal to one If the current letter's count does not equal one, the expression (C< >1) is true and has the value −1. Therefore −(C< >1) equals 1, and CHR$(J * −(C< >1)) equals CHR$(J). The other CHR$ function in line 30 converts the count C into its ASCII value which is also printed. Some tricky but interesting programming!

Several readers sent panagrams from various sources in response to *Problem #14-2: Singles Only.* Mike Skloff (New York, NY) included his favorite typing test, "Pack my box with five dozen liquor jugs" as well as an even shorter "Waltz, nymph, for quick jigs vex Bud." Neither of these are perfect pangrams since they contain duplicate letters. Some of the perfect ones he sent include:

Cwm, fjord-bank glyphs vext quiz.
Zing! Vext cwm fly jabs Kurd qoph.
Milk-vat fez bugs qoph-crwd jynx.

These are from Dmitri A. Borgmann's book *Language on Vacation* (Scribner's, 1965). Mr. Skloff leaves the translations of these sentences up to you. Dig out the unabridged dictionary for these!

Jim Root (Whitmore Lake, MI) sent this sentence containing all the letters: "Wafting zephyrs quickly vexed Jumbo." I think he's talking about a flying elephant. Clifford Dedmore Jr. (North Bend, OR) sent "Cwm kvutza qoph jynx fled brigs" from the *Guinness Book of World Records,* which was supposedly found with the use of three computers. Again, the translation is up to you.

There were many good solutions to *Problem #14-3: Digital Deduction.* Most readers knew that by using binary search techniques the computer can deduce the user's number (between 1 and 1000) in ten or fewer guesses. In fact, since 1024 is two raised to the tenth power, the range of numbers could be 1 to 1024 and still guarantee that not more than ten guesses are needed.

David Alan Wright (New Britain, CT) sent the following solution which requires only (are you ready for this?) nine, yes, nine guesses by the computer! Now before you start throwing the books on mathematical theory at me,

a word of explanation. As David points out, "The maximum number of guesses is nine. After each guess, the possibilities are halved. On the ninth guess, only one possible number is left, and the program *tells* you the answer rather than asks, so a tenth guess is unnecessary." Voilà! His solution is listed below.

```
1 REM COMMODARE #14-3:DIGITAL DEDUCTION
2 REM SOLUTION BY DAVID ALAN WRIGHT
3 REM
10 PRINT" CHOOSE A NUMBER FROM 1 TO 1000
 AND HIT RETURN":INPUT A$:H=1000
20 A$="X":IF(L+H)/2<>L+1THEN N=INT((L+H)
/2):PRINT"IS"N"H, L OR EQUAL";:INPUT A$
30 IF LEFT$(A$,1)="H" THEN H=N:G=G+1:GOT
O 20
40 IF LEFT$(A$,1)="L" THEN L=N:G=G+1:GOT
O 20
50 PRINT"AFTER"G"GUESSES YOUR NUMBER IS
";:IF (L+H)/2=L+1 THEN PRINT L+1:END
60 PRINT N
```

Chuck McGaffin (Ballston Lake, NY) sent an equation for calculating the maximum number of guesses (N) required to find a single item from a group of M items:

```
N = INT(LOG(M)/LOG(2) +1)
```

Wallace Leeker (Lemay, MO) simplified the mathematics of this problem by making his first guess 512. From then on, he merely divided the guess by two and either added or subtracted the result to obtain the next guess. That way he eliminated all the INT and rounding statements that other readers used.

John Deering (Tustin, CA) and Chuck McGaffin both sent separate programs which simulated the entire game. Both programs tabulated the numbers of computer guesses required for each chosen number from 1 to 1000. For example if the user thought of the number 500, the computer would guess it on the first try. If the target number was 250, the computer could guess it on the second try, and so forth. Mr. Dearing's program calculated the maximum and the average number of guesses required for all selected numbers. Mr. McGaffin's program below keeps track of the total of one-guess numbers, two-guess numbers, etc. Perhaps you could expand this concept to find the "safest" targets, i.e., the numbers that require the most computer guesses to deduce.

```
1 REM CHUCK MCGAFFIN
2 REM PROBLEM #14-3 : DIGITAL DEDUCTION
3 REM COMPUTER SIMULATION TO VERIFY THAT
 EVERY NUMBER IS GUESSED IN < 10 TRIES
4 REM
10 FOR N=1 TO 1000:NG=1
20 LL=1:UL=1000:I=500:GOTO 40
30 I=INT((LL+UL)*.5):NG=NG+1
40 IF N<I THEN UL=I-1:GOTO 30
50 IF N>I THEN LL=I+1:GOTO 30
60 IF NG>10 THEN PRINT N
70 G(NG)=G(NG)+1
80 NEXT
90 FOR J=1 TO 10:PRINT G(J);:NEXT
```

The final solutions this month are for *Problem #14-4: Roman Translation*. The user types a Roman numeral and the computer gives the Arabic equivalent. These programs from Clifford Dedmore Jr. (North Bend, OR) and John Immarino (Hackensack, NJ) were chosen from several submitted because of their brevity and because they use such greatly differing approaches to the solution.

```
1 REM CLIFFORD DEDMORE JR.
2 REM PROBLEM #14-4 : ROMAN TRANSLATION
3 REM
10 DIM T(20):INPUT"ENTER ROMAN NUMERAL";
A$
20 FOR K=1 TO LEN(A$):B$=MID$(A$,K,1)
30 L=-(B$="I")-5*(B$="V")-10*(B$="X")-50
*(B$="L")-100*(B$="C")-500*(B$="D")
35 L=L-1000*(B$="M")
40 T(K)=L:NEXT
50 FOR K=1 TO LEN(A$):IF T(K)>=T(K+1) TH
EN TT=TT+T(K):GOTO 70
60 TT=TT+T(K+1)-T(K):K=K+1
70 NEXT:PRINT TT
```

```
1 REM JOHN IMMARINO
2 REM PROBLEM #14-4 : ROMAN TRANSLATION
3 REM
10 V$="MDCLXVI"
20 INPUT"ROMAN NUMERAL";R$:L=7
30 FOR A=LEN(R$) TO 1 STEP -1
40 :X=2:F=5000
50 ::FOR B=1 TO 7
60 :::IF MID$(R$,A,1)=MID$(V$,B,1) THEN
C=B:B=7
70 :::X=ABS(X-7):F=F/X
80 ::NEXT B
90 :T=T+F*((C>L)-(C<=L)):L=C
100 NEXT A
110 PRINT"ARABIC";T:PRINT:T=0:GOTO 20
```

Notice Clifford's use of the "conditional LET" statement in line 102. This technique is based upon the concepts of logical expressions which we discussed above. John also employs a logical expression in line 180 to determine the correct result when a smaller value occurs before a larger value and must be subtracted from it. A good exercise would be to "play computer" and figure out how both of these programs work. Jim Speers (Niles, MI) pointed out that these programs work only if the user types in Roman numerals in the proper format. An input such as "CIVX," for example, will be evaluated, but it *Continued on page 114*

PROGRAM LISTINGS

Attention new *Ahoy!* readers! You must read the following information very carefully prior to typing in programs listed in *Ahoy!* Certain Commodore characters, commands, and strings of characters and commands will appear in a special format. Follow the instructions and listing guide on this page.

On the following pages you'll find several programs that you can enter on your Commodore computer. But before doing so, read this entire page carefully.

To insure clear reproductions, *Ahoy!*'s program listings are generated on a daisy wheel printer, incapable of printing the commands and graphic characters used in Commodore programs. These are therefore represented by various codes enclosed in brackets [ ]. For example: the SHIFT CLR/HOME command is represented onscreen by a heart. The code we use in our listings is [CLEAR]. The chart below lists all such codes which you'll encounter in our listings, except for one other special case.

The other special case is the COMMODORE and SHIFT characters. On the front of most keys are two symbols. The symbol on the left is obtained by pressing that key while holding down the COMMODORE key; the symbol on the right, by pressing that key while holding down the SHIFT key. COMMODORE and SHIFT characters are represented in our listings by a lower-case "s" or "c" followed by the symbol of the key you must hit. COMMODORE J, for example, is represented by [c J], and SHIFT J by [s J].

Additionally, any character that occurs more than two times in a row will be displayed by a coded listing. For example, [3 "[LEFT]"] would be 3 CuRSoR left commands in a row, [5 "[s EP]"] would be 5 SHIFTed English Pounds, and so on. Multiple blank spaces will be noted in similar fashion: 22 spaces, for example, as [22 " "].

Sometimes you'll find a program line that's too long for the computer to accept (C-64 lines are a maximum of 80 characters, or 2 screen lines, long; VIC 20 lines, a maximum of 88 characters, or 4 screen lines). To enter these lines, refer to the *BASIC Command Abbreviations Appendix* in your User Manual.

On the next page you'll find our *Bug Repellent* programs for the VIC 20 and C-64. The version appropriate for your machine will help you proofread our programs after you type them. (Please note: the *Bug Repellent* line codes that follow each program line, in the whited-out area, should *not* be typed in. See the instructions preceding each program.) □

When You See	It Means	You Type		You Will See
[CLEAR]	Screen Clear	SHIFT	CLR/HOME	
[HOME]	Home		CLR/HOME	
[UP]	Cursor Up	SHIFT	↑CRSR↓	
[DOWN]	Cursor Down		↑CRSR↓	
[LEFT]	Cursor Left	SHIFT	←CRSR→	
[RIGHT]	Cursor Right		←CRSR→	
[SS]	Shifted Space	SHIFT	Space	
[INSERT]	Insert	SHIFT	INST/DEL	
[DEL]	Delete		INST/DEL	
[RVSON]	Reverse On	CNTRL	9	
[RVSOFF]	Reverse Off	CNTRL	0	
[UPARROW]	Up Arrow		↑	
[BACKARROW]	Back Arrow		←	
[PI]	PI		π	
[EP]	English Pound		£	

When You See	It Means	You Type		You Will See
[BLACK]	Black	CNTRL	1	
[WHITE]	White	CNTRL	2	
[RED]	Red	CNTRL	3	
[CYAN]	Cyan	CNTRL	4	
[PURPLE]	Purple	CNTRL	5	
[GREEN]	Green	CNTRL	6	
[BLUE]	Blue	CNTRL	7	
[YELLOW]	Yellow	CNTRL	8	
[F1]	Function 1		F1	
[F2]	Function 2	SHIFT	F1	
[F3]	Function 3		F3	
[F4]	Function 4	SHIFT	F3	
[F5]	Function 5		F5	
[F6]	Function 6	SHIFT	F5	
[F7]	Function 7		F7	
[F8]	Function 8	SHIFT	F7	

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** This and the preceding page explain these codes and provide other essential information on entering **Ahoy!** programs. Read these pages **before** entering programs.

BUG REPELLENT

This program will let you debug any *Ahoy!* program. Follow instructions for VIC 20 (cassette or disk) or C-64.

VIC 20 VERSION

By Michael Kleinert and David Barron

For cassette: type in and save the *Bug Repellent* program, then type RUN 63000[RETURN]SYS 828[RETURN]. If you typed the program properly, it will generate a set of two-letter line codes that will match those listed to the right of the respective program lines.

Once you've got a working *Bug Repellent*, type in the program you wish to check. Save it and type the RUN and SYS commands listed above once again, then compare the line codes generated to those listed in the magazine. If you spot a discrepancy, a typing error exists in that line. Important: you must use exactly the same spacing as the program in the magazine. Due to memory limitations on the VIC, the VIC *Bug Repellent* will register an error if your spacing varies from what's printed.

You may type SYS 828 as many times as you wish, but if you use the cassette for anything, type RUN 63000 to restore the *Repellent.*

When your program has been disinfected you may delete all lines from 63000 on. (Be sure the program you type doesn't include lines above 63000!)

For disk: enter *Bug Repellent,* save it, and type RUN:NEW [RETURN]. Type in the program you wish to check, then SYS 828.

To pause the line codes listing, press SHIFT.

To send the list to the printer type OPEN 4,4:CMD 4:SYS 828[RETURN]. When the cursor comes back, type PRINT#4:CLOSE 4[RETURN].

```
•63000 FORX=828TO1023:READY:POKEX,Y:NEXT:END   AC
•63001 DATA169,0,133,63,133,64,165,43,133,251  JL
•63002 DATA165,44,133,252,160,0,132,254,32,228 DF
•63003 DATA3,234,177,251,208,3,76,208,3,230    OE
•63004 DATA251,208,2,230,252,169,244,160,3,32  OH
•63005 DATA30,203,160,0,177,251,170,230,251,20
 8                                             KO
•63006 DATA2,230,252,177,251,32,205,221,169,58 JJ
•63007 DATA32,210,255,169,0,133,253,230,254,32 OK
•63008 DATA228,3,234,165,253,160,0,170,177,251 LG
•63009 DATA201,32,240,6,138,113,251,69,254,170 BP
•63010 DATA138,133,253,177,251,208,226,165,253
 ,41                                           DD
•63011 DATA240,74,74,74,74,24,105,65,32,210    EK
•63012 DATA255,165,253,41,15,24,105,65,32,210  FO
•63013 DATA255,169,13,32,210,255,173,141,2,41  PK
•63014 DATA1,208,249,230,63,208,2,230,64,230   CB
•63015 DATA251,208,2,230,252,76,74,3,169,236   KH
•63016 DATA160,3,32,30,203,166,63,165,64,32    DP
•63017 DATA205,221,169,13,32,210,255,96,230,25
 1                                             EL
•63018 DATA208,2,230,252,96,0,76,73,78,69      OI
•63019 DATA83,58,32,0,76,73,78,69,32,35        FG
•63020 DATA32,0,0,0,0,0                        LE
```

C-64 VERSION

By Michael Kleinert and David Barron

Type in, SAVE, and RUN the *Bug Repellent*. Type NEW, then type in or LOAD the *Ahoy!* program you wish to check. When that's done, SAVE your program (don't RUN it!) and type SYS 49152 [RETURN].

To pause the listing depress and hold the SHIFT key.

Compare the codes your machine generates to the codes listed to the right of the respective program lines. If you spot a difference, an error exists in that line. Jot down the number of lines where contradictions occur, LIST each line, spot the errors, and correct them.

```
•5000 FORX=49152TO49488:READY:POKEX,Y:NEXT:END GJ
•5001 DATA32,161,192,165,43,133,251,165,44,133 DL
•5002 DATA252,160,0,132,254,32,37,193,234,177  DB
•5003 DATA251,208,3,76,138,192,230,251,208,2   OF
•5004 DATA230,252,76,43,192,76,73,78,69,32     KN
•5005 DATA35,32,0,169,35,160,192,32,30,171     CA
•5006 DATA160,0,177,251,170,230,251,208,2,230  CE
•5007 DATA252,177,251,32,205,189,169,58,32,210 JE
•5008 DATA255,169,0,133,253,230,254,32,37,193  CL
•5009 DATA234,165,253,160,0,76,13,193,133,253  NB
•5010 DATA177,251,208,237,165,253,41,240,74,74 MB
•5011 DATA74,74,24,105,65,32,210,255,165,253   EP
•5012 DATA41,15,24,105,65,32,210,255,169,13    GH
•5013 DATA32,220,192,230,63,208,2,230,64,230   AN
•5014 DATA251,208,2,230,252,76,11,192,169,153  NG
•5015 DATA160,192,32,30,171,166,63,165,64,76   BF
•5016 DATA231,192,96,76,73,78,69,83,58,32      EP
•5017 DATA0,169,247,160,192,32,30,171,169,3    PJ
•5018 DATA133,254,32,228,255,201,83,240,6,201  FK
•5019 DATA80,208,245,230,254,32,210,255,169,4  FL
•5020 DATA166,254,160,255,32,186,255,169,0,133 CL
•5021 DATA63,133,64,133,2,32,189,255,32,192    GC
•5022 DATA255,166,254,32,201,255,76,73,193,96  NN
•5023 DATA32,210,255,173,141,2,41,1,208,249    NH
•5024 DATA96,32,205,189,169,13,32,210,255,32   IM
•5025 DATA204,255,169,4,76,195,255,147,83,67   KC
•5026 DATA82,69,69,78,32,79,82,32,80,82        DC
•5027 DATA73,78,84,69,82,32,63,32,0,76         ML
•5028 DATA44,193,234,177,251,201,32,240,6,138  GN
•5029 DATA113,251,69,254,170,138,76,88,192,0   JK
•5030 DATA0,0,0,230,251,208,2,230,252,96       NA
•5031 DATA170,177,251,201,34,208,6,165,2,73    DM
•5032 DATA255,133,2,165,2,208,218,177,251,201  JA
•5033 DATA32,208,212,198,254,76,29,193,0,169   FM
•5034 DATA13,76,210,255,0,0,0                  PA
```

FLANKSPEED FOR THE C-64

By Gordon F. Wheat

Flankspeed will allow you to enter machine language *Ahoy!* programs without any mistakes. Once you have typed the program in, save it for future use. While entering an ML program with *Flankspeed* there is no need to enter spaces or hit the carriage return. This is all done automatically. If you make an error in a line a bell will ring and you will be asked to enter it again. To LOAD in a program Saved with *Flankspeed* use LOAD "name",1,1 for tape, or LOAD "name",8,1 for disk. The function keys may be used after the starting and ending addresses have been entered.

f1 – SAVEs what you have entered so far.

f3 – LOADs in a program worked on previously.

f5 – To continue on a line you stopped on after LOADing in the previously saved work.

f7 – Scans through the program to locate a particular line, or to find out where you stopped the last time you entered the program. f7 temporarily freezes the output as well.

```
•5 POKE53280,12:POKE53281,11                   LL
•6 PRINT"[CLEAR][c 8][RVSON][15" "]FLANKSPEED[
 15" "]";                                      ED
•10 PRINT"[RVSON][5" "]MISTAKEPROOF ML ENTRY P
 ROGRAM[6" "]"                                 MC
•15 PRINT"[RVSON][9" "]CREATED BY G. F. WHEAT[
 9" "]"                                        DM
•20 PRINT"[RVSON][3" "]COPR. 1984, ION INTERNA
```

```
TIONAL INC.[3" "]"                                    DH
·30 FORA=54272TO54296:POKEA,0:NEXT                    IM
·40 POKE54272,4:POKE54273,48:POKE54277,0:POKE5
4278,249:POKE54296,15                                 NH
·70 FORA=680TO699:READB:POKEA,B:NEXT                  KO
·75 DATA169,251,166,253,164,254,32,216,255,96         HJ
·76 DATA169,0,166,251,164,252,32,213,255,96           JB
·80 B$="STARTING ADDRESS IN HEX":GOSUB2010:AD=
B:SR=B                                                HC
·85 GOSUB2520:IFB=0THEN80                             FO
·86 POKE251,T(4)+T(3)*16:POKE252,T(2)+T(1)*16         KE
·90 B$="ENDING ADDRESS IN HEX":GOSUB2010:EN=B         IF
·95 GOSUB2510:IFB=0THEN80                             FP
·96 POKE254,T(2)+T(1)*16:B=T(4)+1+T(3)*16             MN
·97 IFB>255THENB=B-255:POKE254,PEEK(254)+1            GE
·98 POKE253,B:PRINT                                   HN
·100 REM  GET HEX LINE                                IL
·110 GOSUB3010:PRINT": [c P][LEFT]";:FORA=0TO8        FG
·120 FORB=0TO1:GOTO210                                MD
·125 NEXTB                                            ME
·130 A%(A)=T(1)+T(0)*16:IFAD+A-1=ENTHEN310            LH
·135 PRINT" [c P][LEFT]";                             IK
·140 NEXTA:T=AD-(INT(AD/256)*256):PRINT" "            PD
·150 FORA=0TO7:T=T+A%(A):IFT>255THENT=T-255           LK
·160 NEXT                                             IA
·170 IFA%(8)<>TTHENGOSUB1010:GOTO110                  FK
·180 FORA=0TO7:POKEAD+A,A%(A):NEXT:AD=AD+8:GOT
0110                                                  MN
·200 REM    GET HEX INPUT                             AB
·210 GETA$:IFA$=""THEN210                             HO
·211 IFA$=CHR$(20)THEN270                             GC
·212 IFA$=CHR$(133)THEN4000                           MD
·213 IFA$=CHR$(134)THEN4100                           KF
·214 IFA$=CHR$(135)THENPRINT" ":GOTO4500              GE
·215 IFA$=CHR$(136)THENPRINT" ":GOTO4700              BJ
·220 IFA$>"@"ANDA$<"G"THENT(B)=ASC(A$)-55:GOTO
250                                                   GM
·230 IFA$>"/"ANDA$<":"THENT(B)=ASC(A$)-48:GOTO
250                                                   LE
·240 GOSUB1100:GOTO210                                LL
·250 PRINTA$"[c P][LEFT]";                            OA
·260 GOTO125                                          CG
·270 IFA>0THEN280                                     OP
·272 A=-1:IFB=1THEN290                                OB
·274 GOTO140                                          CJ
·280 IFB=0THENPRINTCHR$(20);CHR$(20);:A=A-1           HG
·285 A=A-1                                            BE
·290 PRINTCHR$(20);:GOTO140                           KH
·300 REM LAST LINE                                    AD
·310 PRINT" ":T=AD-(INT(AD/256)*256)                  GJ
·320 FORB=0TOA-1:T=T+A%(B):IFT>255THENT=T-255         PL
·330 NEXT                                             IA
·340 IFA%(A)<>TTHENGOSUB1010:GOTO110                  KF
·350 FORB=0TOA-1:POKEAD+B,A%(B):NEXT                  HN
·360 PRINT:PRINT"YOU ARE FINISHED!":GOTO4000          ON
·1000 REM BELL AND ERROR MESSAGES                     FL
·1010 PRINT:PRINT"LINE ENTERED INCORRECTLY":PR
INT:GOTO1100                                          DH
·1020 PRINT:PRINT"INPUT A 4 DIGIT HEX VALUE!":
GOTO1100                                              JA
·1030 PRINT:PRINT"ENDING IS LESS THAN STARTING
!":B=0:GOTO1100                                       HD
·1040 PRINT:PRINT"ADDRESS NOT WITHIN SPECIFIED
 RANGE!":B=0:GOTO1100                                 AG
·1050 PRINT:PRINT"NOT ZERO PAGE OR ROM!":B=0:G
OTO1100                                               KN
·1060 PRINT"?ERROR IN SAVE":GOTO1100                  EI
·1070 PRINT"?ERROR IN LOAD":GOTO1100                  GL
·1080 PRINT:PRINT:PRINT"END OF ML AREA":PRINT         PG
·1100 POKE54276,17:POKE54276,16:RETURN                BH
·1200 OPEN15,8,15:INPUT#15,A,A$:CLOSE15:PRINTA
$:RETURN                                              IM
·2000 REM GET FOUR DIGIT HEX                          PC
·2010 PRINT:PRINTB$;:INPUTT$                          GM
·2020 IFLEN(T$)<>4THENGOSUB1020:GOTO2010              II
·2040 FORA=1TO4:A$=MID$(T$,A,1):GOSUB2060:IFT(
A)=16THENGOSUB1020:GOTO2010                           AD
·2050 NEXT:B=(T(1)*4096)+(T(2)*256)+(T(3)*16)+
T(4):RETURN                                           GF
·2060 IFA$>"@"ANDA$<"G"THENT(A)=ASC(A$)-55:RET
URN                                                   EH
·2070 IFA$>"/"ANDA$<":"THENT(A)=ASC(A$)-48:RET
URN                                                   KP
·2080 T(A)=16:RETURN                                  NP
·2500 REM ADRESS CHECK                                LI
·2510 IFAD>ENTHEN1030                                 MI
·2515 IFB<SRORB>ENTHEN1040                            MG
·2520 IFB<256OR(B>40960ANDB<49152)ORB>53247THE
N1050                                                 MI
·2530 RETURN                                          IM
·3000 REM ADDRESS TO HEX                              EB
·3010 AC=AD:A=4096:GOSUB3070                          HG
·3020 A=256:GOSUB3070                                 CE
·3030 A=16:GOSUB3070                                  PN
·3040 A=1:GOSUB3070                                   MJ
·3060 RETURN                                          IM
·3070 T=INT(AC/A):IFT>9THENA$=CHR$(T+55):GOTO3
090                                                   CJ
·3080 A$=CHR$(T+48)                                   JP
·3090 PRINTA$;:AC=AC-A*T:RETURN                       AC
·4000 A$="**SAVE**":GOSUB4200                         AI
·4050 OPEN1,T,1,A$:SYS680:CLOSE1                      LH
·4060 IFST=0THENEND                                   EO
·4070 GOSUB1060:IFT=8THENGOSUB1200                    FJ
·4080 GOTO4000                                        FF
·4100 A$="**LOAD**":GOSUB4200                         AB
·4150 OPEN1,T,0,A$:SYS690:CLOSE1                      MF
·4160 IFST=64THEN110                                  JH
·4170 GOSUB1070:IFT=8THENGOSUB1200                    CM
·4180 GOTO4100                                        FO
·4200 PRINT" ":PRINTTAB(14)A$                         FG
·4210 PRINT:A$="":INPUT"FILENAME";A$                  OM
·4215 IFA$=""THEN4210                                 GF
·4220 PRINT:PRINT"TAPE OR DISK?":PRINT                DF
·4230 GETB$:T=1:IFB$="D"THENT=8:A$="@0:"+A$:RE
TURN                                                  IG
·4240 IFB$<>"T"THEN4230                               FN
·4250 RETURN                                          IM
·4500 B$="CONTINUE FROM ADDRESS":GOSUB2010:AD=
B                                                     DK
·4510 GOSUB2515:IFB=0THEN4500                         MA
·4520 PRINT:GOTO110                                   OI
·4700 B$="BEGIN SCAN AT ADDRESS":GOSUB2010:AD=
B                                                     FH
·4705 GOSUB2515:IFB=0THEN4700                         NK
·4706 PRINT:GOTO4740                                  DI
·4710 FORB=0TO7:AC=PEEK(AD+B):GOSUB3030:IFAD+B
=ENTHENAD=SR:GOSUB1080:GOTO110                        BK
·4715 PRINT" ";:NEXTB                                 EC
·4720 PRINT:AD=AD+8                                   GN
·4730 GETB$:IFB$=CHR$(136)THEN110                     MN
·4740 GOSUB3010:PRINT": ";:GOTO4710                   JD
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering *Ahoy!* programs. Refer to these pages **before** entering any programs!

The Ultimate Resolution

FROM PAGE 37

```
•1 REM                                            JD
•2 REM       RUPERT REPORT #18                    PA
•3 REM       LISTING                              LI
•4 REM       BIT MAP GRAPHICS                     KG
•5 REM                                            JD
•10 DEF FNSB(N)=PEEK(MM) OR 2[UPARROW]N           LG
•20 DEF FNRB(N)=PEEK(MM) AND (255-2[UPARR
 OW]N)                                            FP
•30 VV=53248 :REM VIC-II REGISTER 0               FL
•35 :REM >>> PUT BIT MAP AT 8192 <<<
    (SET BIT 3 OF VIC REGISTER 24)                JA
•40 MM=VV+24 : POKE MM,FNSB(3)                    OO
•45 :REM >>> SELECT BIT MAP MODE <<<
    (SET BIT 5 OF VIC REGISTER 17)                DH
•50 MM=VV+17 : POKE MM,FNSB(5)                    JM
•60 BASE=8192 :REM START BIT MAP MEMORY           KD
•65 :REM >>> CLEAR BIT MAP <<<                    HG
•70 FOR MM=BASE TO BASE+7999                      FN
•80 POKE MM,0 : NEXT MM                           OP
•85 :REM >>> SELECT COLORS C1 AND C0 <<<          LC
•90 C1=1 : C0=0 : CC=16*C1 + C0                   OM
•95 :REM >>FILL SCREEN MEMORY WITH COLOR          AI
•100 FOR MM=1024 TO 2023:POKE MM,CC:NEXT          OM
•194 :                                            DI
•195 ::REM:: MAIN PROGRAM ::                      AE
•196 :                                            DI
•200 FOR N=1 TO 1000                              CJ
•210 X=RND(0)*320 : Y=RND(0)*200                  PO
•220 GOSUB 400 : NEXT                             NN
•250 FOR P=1 TO 3000 : NEXT                       NE
•294 :                                            DI
•296 :                                            DI
•300 :REM >>> RESET BIT MAP MODE <<<              HJ
•310 MM=VV+17 : POKE MM,FNRB(5)                   JN
•320 :REM >>> RESTORE SCREEN MEMORY BASE          GC
•330 MM=VV+24 : POKE MM,FNRB(3)                   MP
•390 END                                          IC
•395 :REM >>> TURN ON PIXEL AT (X,Y)              OB
•400 BIT=7-(X AND 7)                              PJ
•410 MM=BASE+320*INT(Y/8)+8*INT(X/8)+(Y A
 ND 7)                                            AP
•420 POKE MM,FNSB(BIT)                            MO
•430 RETURN                                       IM
```

Sing a Song of Anything

FROM PAGE 18

THREE-VOICE PLAYER

```
•1 REM "THREE VOICE PLAYER"                       MM
•2 REM PLAY 1, 2, OR 3 VOICES WITH THIS R
 OUTINE                                           OP
•3 REM ADD IT TO YOUR PROGRAMS: ADJUST TH
 E DURATIONS AT 9200-9210 AS NEEDED               MJ
•4 REM                                            JD
•5 REM PLAYS "GOD SAVE THE KING" ("MY COU
 NTRY, 'TIS OF THEE")                             CL
•6 REM                                            JD
•10 GOSUB 9000:GOTO 120                           LE
•60 FOR N=1 TO LEN(MD$(PH))                       FJ
•61 FOR VC=0 TO EV%                               GG
•62 POKE GR(VC),UG%(VC):REM NORMAL NOTES;
 DON'T POKE UG% FOR LEGATO                        AE
•63 FOR I=0 TO 1                                  JB
•64 POKE FR(VC,I),PI%(ASC(MID$(ME$(PH,VC)
 ,N,1)),I)                                        BD
•65 NEXT:NEXT                                     EF
•66 FOR VC=EV% TO 0 STEP -1:POKE GR(VC),G
 %(VC):NEXT                                       MB
•67 FOR I=0 TO DU%(VAL(MID$(MD$(PH),N,1))
 ):NEXT                                           JB
•68 REM FOR VC=0 TO EV%:POKE GR(VC),UG%(V
 C):NEXT:REM STACCATO NOTES                       BO
•69 NEXT:PH=PH+1:IF PH>ES% THEN PH=0              IJ
•70 FOR VC=0 TO EV%:POKE GR(VC),UG%(VC):N
 EXT:RETURN                                       EP
•100 GOSUB 60                                     PC
•110 IF PEEK(653)>0 THEN END                      FF
•120 PRINT "PHRASE "PH                            FC
•190 GOTO 100                                     CF
•8997 REM                                         JD
•8998 REM SET UP SOUND SHAPE                      FD
•8999 REM                                         JD
•9000 DIM MD$(23),ME$(23,2),MV$(23,2),G%(
 2),GR(2),FR(2,1),AD(2)                           CF
•9001 DIM DU%(9),PI%(168,1),AK%(2),DY%(2)
 ,SN%(2),RE%(2),WF%(2)                            OF
•9007 REM                                         JD
•9008 REM ATTACK--VOICES 0,1,2                    KG
•9009 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SHARPER ATTACK                                OK
•9010 AK%(0)=2:AK%(1)=2:AK%(2)=2                  AN
•9015 FOR I=0 TO 2:AK%(I)=AK%(I)*16:NEXT          FF
•9017 REM                                         JD
•9018 REM DECAY--VOICES 0,1,2                     PK
•9019 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=FASTER DECLINE                                GA
•9020 DY%(0)=4:DY%(1)=6:DY%(2)=6                  NC
•9027 REM                                         JD
•9028 REM SUSTAIN--VOICES 0,1,2                   FC
•9029 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SOFTER VOLUME DURING SUSTAIN                  JM
•9030 SN%(0)=12:SN%(1)=8:SN%(2)=9                 FB
•9035 FOR I=0 TO 2:SN%(I)=SN%(I)*16:NEXT          BD
•9037 REM                                         JD
•9038 REM RELEASE--VOICES 0,1,2                   OK
•9039 REM NUMBER FROM 0 TO 15; LOWER NUMB
```

```
ER=FASTER DROP TO SILENCE AT END               PJ
·9040 RE%(0)=0:RE%(1)=3:RE%(2)=5               BG
·9047 REM                                      JD
·9048 REM SET SOUND ADDRESSES                  JC
·9049 REM                                      JD
·9050 FR(0,0)=54272:FR(1,0)=54279:FR(2,0)
=54286                                         PG
·9055 FOR I=0 TO 2:FR(I,1)=1+FR(I,0):GR(I
)=FR(I,0)+4:AD(I)=GR(I)+1:NEXT                 HJ
·9057 REM                                      JD
·9058 REM POKE ADSR ENVELOPES                  JL
·9059 REM                                      JD
·9060 FOR I=0 TO 2:POKE AD(I),AT%(I) OR D
Y%(I)                                          EN
·9065 POKE AD(I)+1,SN%(I) OR RE%(I):NEXT       DK
·9066 REM                                      JD
·9067 REM SET UP GATES                         JN
·9068 REM WAVEFORMS, VOICES 0,1,2 (ADD VA
LUES):                                         DJ
·9069 REM TRIANGLE ON=16; SAWTOOTH ON=32;
 PULSE ON=64 (SET WIDTH!); NOISE ON=128        IL
·9070 WF%(0)=64:WF%(1)=64:WF%(2)=32            HP
·9075 FOR I=0 TO 2:G%(I)=1 OR WF%(I):UG%(
I)=G%(I)AND 254:NEXT                           AB
·9077 REM                                      JD
·9078 REM SET PULSE WIDTHS                     AC
·9079 REM VOICES 0,1,2; LOW BYTE, HIGH BY
TE                                             MG
·9080 POKE GR(0)-2,200:POKE GR(0)-1,3          JD
·9081 POKE GR(1)-2,200:POKE GR(1)-1,3          LD
·9082 POKE GR(2)-2,200:POKE GR(2)-1,3          EP
·9096 REM                                      JD
·9097 REM SET UP PITCH ARRAY                   DK
·9098 REM EACH NOTE, IN ALL ITS OCTAVES        JB
·9099 REM C                                    NE
·9100 X%=3:GOSUB 9190                          BK
·9101 DATA 12,1,24,2,48,4,97,8,195,16,135
,33,15,67,30,134                               IF
·9102 REM D                                    NH
·9103 X%=4:GOSUB 9190                          PH
·9104 DATA 45,1,90,2,180,4,104,9,209,18,1
62,37,69,75,139,150                            PA
·9105 REM E (F-FLAT)                           MH
·9106 X%=5:GOSUB 9190:Y%=13:GOSUB 9195         DN
·9107 DATA 81,1,163,2,71,5,143,10,31,21,6
2,42,125,84,250,168                            HM
·9108 REM F (E-SHARP)                          DB
·9109 X%=6:GOSUB 9190:Y%=19:GOSUB 9195         GE
·9110 DATA 102,1,204,2,152,5,48,11,96,22,
193,44,131,89,6,179                            IL
·9111 REM G                                    NI
·9112 X%=7:GOSUB 9190                          AO
·9113 DATA 145,1,35,3,71,6,143,12,30,25,6
0,50,121,100,243,200                           GM
·9114 REM A                                    NC
·9115 X%=1:GOSUB 9190                          PA
·9116 DATA 195,1,134,3,12,7,24,14,49,28,9
9,56,199,112,143,225                           PI
·9117 REM B                                    NF
·9118 X%=2:GOSUB 9190                          PF
·9119 DATA 250,1,244,3,233,7,210,15,165,3
1,75,63,151,126,46,253                         CF
·9120 REM D-FLAT (C-SHARP)                     JL
·9121 X%=11:GOSUB 9190:Y%=17:GOSUB 9195        NN
·9122 DATA 28,1,56,2,112,4,225,8,195,17,1
34,35,12,71,24,142                             KJ
·9123 REM E-FLAT (D-SHARP)                     FD
·9124 X%=12:GOSUB 9190:Y%=18:GOSUB 9195        LD
·9125 DATA 62,1,125,2,251,4,247,9,239,19,
223,39,191,79,126,159                          FB
·9126 REM G-FLAT (F-SHARP)                     HH
·9127 X%=14:GOSUB 9190:Y%=20:GOSUB 9195        HK
·9128 DATA 123,1,246,2,237,5,218,11,181,2
3,107,47,214,94,172,189                        HG
·9129 REM A-FLAT (G-SHARP)                     HE
·9130 X%=8:GOSUB 9190:Y%=21:GOSUB 9195         GN
·9131 DATA 169,1,83,3,167,6,78,13,156,26,
57,53,115,106,230,212                          PA
·9132 REM B-FLAT (A-SHARP)                     FP
·9133 X%=9:GOSUB 9190:Y%=15:GOSUB 9195         DD
·9134 DATA 221,1,187,3,119,7,239,14,223,2
9,190,59,124,119,248,238                       CN
·9135 REM C-FLAT                               CH
·9136 X%=10:GOSUB 9190                         DL
·9137 DATA 4,1,250,1,244,3,233,7,210,15,1
65,31,75,63,151,126                            AK
·9138 REM B-SHARP                              IN
·9139 X%=16:GOSUB 9190                         CJ
·9140 DATA 24,2,48,4,97,8,195,16,135,33,1
5,67,30,134,255,255                            NM
·9185 GOTO 9200                                FM
·9189 REM READ PITCHES                         NA
·9190 FOR I=0 TO 147 STEP 21:READ PI%(I+X
%,0),PI%(I+X%,1):NEXT:RETURN                   FN
·9194 REM IDENTICAL PITCHES                    GA
·9195 FOR I=0 TO 147 STEP 21:PI%(I+Y%,0)=
PI%(I+X%,0):PI%(I+Y%,1)=PI%(I+X%,1)            LN
·9196 NEXT:RETURN                              EJ
·9197 REM                                      JD
·9198 REM SET UP DURATIONS                     ME
·9199 REM                                      JD
·9200 FOR I=0 TO 9:READ DU%(I):NEXT            MB
·9205 DATA 0,128,256,384,512,640,768,1024
,1152,1280                                     CA
·9296 REM                                      JD
·9297 REM SET FILTER AND VOLUME                BN
·9298 REM FILTER FREQUENCY                     DE
·9299 REM LOW BYTE (0-7) X%; HIGH BYTE (0
-255) Y%                                       PA
·9300 X%=0:Y%=100                              GD
·9305 POKE 54293,X%:POKE 54294,Y%              KJ
·9308 REM FILTER ON?                           DD
·9309 REM VOICE 1 ON=1; 2 ON=2; 3 ON=4; 1
&2 ON=3; 2&3 ON=6; ALL ON=7                    AL
·9310 X%=0                                     FM
·9318 REM FILTER RESONANCE                     CE
```

```
9319 REM PEAK VOLUME (0=LOW, 15=HIGH)     FH
9320 Y%=14                                JL
9325 Y%=Y%*16:POKE 54295,X% OR Y%         MG
9328 REM SELECT FILTER TYPE               CP
9329 REM LOW-PASS=1;BAND-PASS=2;HIGH-PAS
S=4;LO-BAND=3;HI-BAND=6;ALL=7             MH
9330 X%=1                                 FP
9335 X%=X%*16                             LC
9337 REM                                  JD
9338 REM SELECT OVERALL VOLUME            FJ
9339 REM 15=HIGH, 0=LOW                   PB
9340 Y%=15                                JK
9345 POKE 54296,X% OR Y%                  HN
9496 REM                                  JD
9497 REM SET MELODIES HERE                PA
9498 REM                                  JD
9499 REM HOW MANY VOICES? (MINUS ONE)     GN
9500 EV%=2                                KA
9508 REM                                  JD
9509 REM HOW MANY PHRASES? (MINUS ONE)    MA
9510 ES%=1                                JO
9514 REM                                  JD
9515 REM MELODY STRINGS                   JJ
9516 REM                                  JD
9517 REM EACH PHRASE HAS ONLY ONE DU%(PH
) STRING, NO MATTER HOW MANY VOICES       AO
9518 REM EACH PHRASE HAS ONE ME$(PH,VC)
& ONE MV$(PH,VC) STRING PER VOICE         IP
9519 REM PHRASE 0                         IP
9520 MD$(0)="[3"2"]40[4"2"]40[4"2"]8"     GK
9521 ME$(0,0)="FFGEFGAA[c B]AGFGFEF"      JC
9522 MV$(0,0)="5[15" "]"                  KL
9523 ME$(0,1)="CCDCDECFGFEADAGC"          KI
9524 MV$(0,1)="5[12" "]4 5"               PB
9525 ME$(0,2)="FA[c B][3"C"]FD[c B]CCD[c
 B]CCA"                                   DG
9526 MV$(0,2)="3  234  34  343 "          HP
9529 REM PHRASE 1                         IO
9530 MD$(1)="[3"2"]40[4"2"]4022[4"0"]402
00228"                                    BD
9531 ME$(1,0)="[4"C"][c B]A[4"[c B]"]AGA
[c B]AGFA[c B]CD[c B]AGF"                 JD
9532 MV$(1,0)="6[3" "]5[14" "]6 5[3" "]" LP
9533 ME$(1,1)="[4"A"]GF[4"G"]FEFF@F@FEFF
GFEA"                                     IK
9534 MV$(1,1)="43 4[3" "]3 4[3" "]3[3" "
]4[6" "]3"                                EO
9535 ME$(1,2)="FAC[3"F"]CEGCBCFDC[c B]AC
GA[c B]DCCF"                              HN
9536 MV$(1,2)="2 32[6" "]1234 3  2  3 21
"                                         CL
9897 REM                                  JD
9898 REM CONVERT STRINGS TO USABLE FORM   IG
9899 REM                                  JD
9900 FOR PH=0 TO ES%:FOR VC=0 TO EV%      AH
9905 A$=ME$(PH,VC):ME$(PH,VC)=""          EC
9910 FOR I=1 TO LEN(A$)                   OE
9920 X%=ASC(MID$(A$,I,1))                 IP
9930 IF X%<72 THEN X%=X%-64:IF X%<0 THEN
 X%=0                                     ED
9931 IF X%>192AND X%<200 THEN X%=X%-178   GP
9932 IF X%=176 THEN X%=8                  IF
9933 IF X%=191 THEN X%=9                  FN
9934 IF X%=188 THEN X%=10                 II
9935 IF X%=172 THEN X%=11                 IM
9936 IF X%=177 THEN X%=12                 LA
9937 IF X%=187 THEN X%=13                 IE
9938 IF X%=165 THEN X%=14                 HL
9939 IF X%>21 THEN X%=0                   DL
9950 V$=MID$(MV$(PH,VC),I,1):IF V$<>" "
THEN Y%=21*VAL(V$)                        PG
9960 X%=X%+Y%                             MJ
9970 ME$(PH,VC)=ME$(PH,VC)+CHR$(X%)       OC
9975 NEXT:NEXT:NEXT                       PI
9980 PH=0                                 HP
9990 RETURN                               IM
```

ONE-VOICE PLAYER

```
1 REM ONE VOICE PLAYER (FAST)             EH
2 REM PLAYS "MEXICAN HAT DANCE"           NB
3 REM                                     JD
10 GOSUB 9000:GOTO 120                    LE
60 FOR N=1 TO LEN(MD$(PH))                FJ
61 D%=VAL(MID$(MD$(PH),N,1))              LE
64 POKE GR,UG%:REM NORMAL NOTES; DELETE
POKES FOR LEGATO                          IF
65 FOR I=0 TO 1:POKE FR(I),PI%(ASC(MID$(
ME$(PH),N,1)),I):NEXT                     JN
66 POKE GR,G%                             NA
67 FOR I=0 TO DU%(VAL(MID$(MD$(PH),N,1))
):NEXT                                    JB
68 REM POKE GR,UG%:REM STACCATO NOTES     EE
69 NEXT:PH=PH+1:IF PH>ES% THEN PH=0       IJ
70 POKE GR,UG:RETURN                      NF
100 GOSUB 60                              PC
110 IF PEEK(653)>0 THEN END               FF
120 PRINT "PHRASE "PH                     FC
190 GOTO 100                              CF
8997 REM                                  JD
8998 REM SET UP SOUND SHAPE               FD
8999 REM                                  JD
9000 DIM MV$(23),MD$(23),ME$(23),FR(1)    JI
9001 DIM DU%(9),PI%(168,1)                PB
9007 REM                                  JD
9008 REM ATTACK                           FE
9009 REM NUMBER FROM 0 TO 15; LOWER NUMB
ER=SHARPER ATTACK                         OK
9010 AK%=0                                JL
9015 AK%=AK%*16                           DL
9017 REM                                  JD
9018 REM DECAY                            PJ
9019 REM NUMBER FROM 0 TO 15; LOWER NUMB
ER=FASTER DECLINE                         GA
9020 DY%=5                                KF
9027 REM                                  JD
9028 REM SUSTAIN                          NH
```

```
•9029 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SOFTER VOLUME DURING SUSTAIN           JM
•9030 SN%=1                                LL
•9035 SN%=SN%*16                           HB
•9037 REM                                  JD
•9038 REM RELEASE                          IP
•9039 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=FASTER DROP TO SILENCE AT END          PJ
•9040 RE%=0                                KA
•9047 REM                                  JD
•9048 REM SET SOUND ADDRESSES              JC
•9049 REM                                  JD
•9050 FR(0)=54272                          OK
•9055 FR(1)=1+FR(0):GR=FR(0)+4:AD=GR+1     CI
•9057 REM                                  JD
•9058 REM POKE ADSR ENVELOPE               FE
•9059 REM                                  JD
•9060 POKE AD,AT% OR DY%                   KD
•9065 POKE AD+1,SN% OR RE%                 GJ
•9066 REM                                  JD
•9067 REM SET UP GATE                      EN
•9068 REM WAVEFORMS (ADD VALUES):          GB
•9069 REM TRIANGLE ON=16; SAWTOOTH ON=32;
  PULSE ON=64 (SET WIDTH!); NOISE ON=128   IL
•9070 WF%=32                               NP
•9075 G%=1 OR WF%:UG%=G% AND 254           EJ
•9077 REM                                  JD
•9078 REM SET PULSE WIDTH                  MG
•9079 REM LOW BYTE, HIGH BYTE              FB
•9080 POKE GR-2,200:POKE GR-1,3            HO
•9096 REM                                  JD
•9097 REM SET UP PITCH ARRAY               DK
•9098 REM EACH NOTE, IN ALL ITS OCTAVES    JB
•9099 REM C                                NE
•9100 X%=3:GOSUB 9190                      BK
•9101 DATA 12,1,24,2,48,4,97,8,195,16,135
 ,33,15,67,30,134                          IF
•9102 REM D                                NH
•9103 X%=4:GOSUB 9190                      PH
•9104 DATA 45,1,90,2,180,4,104,9,209,18,1
 62,37,69,75,139,150                       PA
•9105 REM E (F-FLAT)                       MH
•9106 X%=5:GOSUB 9190:Y%=13:GOSUB 9195     DN
•9107 DATA 81,1,163,2,71,5,143,10,31,21,6
 2,42,125,84,250,168                       HM
•9108 REM F (E-SHARP)                      DB
•9109 X%=6:GOSUB 9190:Y%=19:GOSUB 9195     GE
•9110 DATA 102,1,204,2,152,5,48,11,96,22,
 193,44,131,89,6,179                       IL
•9111 REM G                                NI
•9112 X%=7:GOSUB 9190                      AO
•9113 DATA 145,1,35,3,71,6,143,12,30,25,6
 0,50,121,100,243,200                      GM
•9114 REM A                                NC
•9115 X%=1:GOSUB 9190                      PA
•9116 DATA 195,1,134,3,12,7,24,14,49,28,9
 9,56,199,112,143,225                      PI
•9117 REM B                                NF
•9118 X%=2:GOSUB 9190                      PF
•9119 DATA 250,1,244,3,233,7,210,15,165,3
 1,75,63,151,126,46,253                    CF
•9120 REM D-FLAT (C-SHARP)                 JL
•9121 X%=11:GOSUB 9190:Y%=17:GOSUB 9195    NN
•9122 DATA 28,1,56,2,112,4,225,8,195,17,1
 34,35,12,71,24,142                        KJ
•9123 REM E-FLAT (D-SHARP)                 FD
•9124 X%=12:GOSUB 9190:Y%=18:GOSUB 9195    LD
•9125 DATA 62,1,125,2,251,4,247,9,239,19,
 223,39,191,79,126,159                     FB
•9126 REM G-FLAT (F-SHARP)                 HH
•9127 X%=14:GOSUB 9190:Y%=20:GOSUB 9195    HK
•9128 DATA 123,1,246,2,237,5,218,11,181,2
 3,107,47,214,94,172,189                   HG
•9129 REM A-FLAT (G-SHARP)                 HE
•9130 X%=8:GOSUB 9190:Y%=21:GOSUB 9195     GN
•9131 DATA 169,1,83,3,167,6,78,13,156,26,
 57,53,115,106,230,212                     PA
•9132 REM B-FLAT (A-SHARP)                 FP
•9133 X%=9:GOSUB 9190:Y%=15:GOSUB 9195     DD
•9134 DATA 221,1,187,3,119,7,239,14,22[illegible],2
 9,190,59,124,119,248,238                  CN
•9135 REM C-FLAT                           CH
•9136 X%=10:GOSUB 9190                     DL
•9137 DATA 4,1,250,1,244,3,233,7,210,15,1
 65,31,75,63,151,126                       AK
•9138 REM B-SHARP                          IN
•9139 X%=16:GOSUB 9190                     CJ
•9140 DATA 24,2,48,4,97,8,195,16,135,33,1
 5,67,30,134,255,255                       NM
•9150 FOR I=0 TO 147 STEP 21:PI%(I,0)=0:P
 I%(I,1)=0:NEXT                            CM
•9185 GOTO 9200                            FM
•9189 REM READ PITCHES                     NA
•9190 FOR I=0 TO 147 STEP 21:READ PI%(I+X
 %,0),PI%(I+X%,1):NEXT:RETURN              FN
•9194 REM IDENTICAL PITCHES                GA
•9195 FOR I=0 TO 147 STEP 21:PI%(I+Y%,0)=
 PI%(I+X%,0):PI%(I+Y%,1)=PI%(I+X%,1)       LN
•9196 NEXT:RETURN                          EJ
•9197 REM                                  JD
•9198 REM SET UP DURATIONS                 ME
•9199 REM                                  JD
•9200 FOR I=0 TO 9:READ DU%(I):NEXT        MB
•9205 DATA 16,32,48,64,96,128,160,192,256
 ,320                                      PD
•9296 REM                                  JD
•9297 REM SET FILTER AND VOLUME            BN
•9298 REM FILTER FREQUENCY                 DE
•9299 REM LOW BYTE (0-7) X%; HIGH BYTE (0
 -255) Y%                                  PA
•9300 X%=0:Y%=100                          GD
•9305 POKE 54293,X%:POKE 54294,Y%          KJ
•9308 REM FILTER ON?                       DD
•9309 REM VOICE 1 ON=1                     FK
•9310 X%=0                                 FM
•9318 REM FILTER RESONANCE                 CE
```

```
·9319 REM PEAK VOLUME (0=LOW, 15=HIGH)    FH
·9320 Y%=14                               JL
·9325 Y%=Y%*16:POKE 54295,X% OR Y%        MG
·9328 REM SELECT FILTER TYPE              CP
·9329 REM LOW-PASS=1;BAND-PASS=2;HIGH-PAS
S=4;LO-BAND=3;HI-BAND=6;ALL=7             MH
·9330 X%=1                                FP
·9335 X%=X%*16                            LC
·9337 REM                                 JD
·9338 REM SELECT OVERALL VOLUME           FJ
·9339 REM 15=HIGH, 0=LOW                  PB
·9340 Y%=15                               JK
·9345 POKE 54296,X% OR Y%                 HN
·9496 REM                                 JD
·9497 REM SET MELODY                      EJ
·9498 REM                                 JD
·9509 REM HOW MANY PHRASES? (MINUS ONE)   MA
·9510 ES%=5                               KC
·9514 REM                                 JD
·9515 REM MELODY STRINGS                  JJ
·9516 REM                                 JD
·9517 REM EACH PHRASE HAS ONLY ONE DU%(PH
%) STRING, NO MATTER HOW MANY VOICES      CE
·9518 REM EACH PHRASE HAS ONE ME$(PH%,VC%
) & ONE MV$(PH%,VC%) STRING PER VOICE     NB
·9519 REM PHRASE 0                        IP
·9520 MD$(0)="[9"0"]4[9"0"]4"             FA
·9521 ME$(0)="G[s F]GE[s D]ECBCGEFGABCDEF
D"                                        NL
·9522 MV$(0)="6[6" "]565[5" "]6[4" "]"    HN
·9529 REM PHRASE 1                        IO
·9530 MD$(1)="[9"0"]4[8"0"]6"             NA
·9531 ME$(1)="FEFD[s C]DB[s A]BGG[s F]GAG
FEDC"                                     OF
·9532 MV$(1)="6[5" "]5[3" "]6[8" "]"      PF
·9539 REM PHRASE 2                        JB
·9540 MD$(2)="[7"0"]15[7"0"]15"           PN
·9541 ME$(2)="GC@GC@GC@GCDCB@CD@"         AO
·9542 MV$(2)="34 34 34 34  3 4  "         FO
·9549 REM PHRASE 3                        JA
·9550 MD$(3)="[7"0"]15[7"0"]15"           EO
·9551 ME$(3)="GB@GB@GB@GBCBA@BC@"         AA
·9552 MV$(3)="3[10" "]43[3" "]4 "         PM
·9559 REM PHRASE 4                        JD
·9560 MD$(4)="[9"1"]5[9"1"]5"             PA
·9561 ME$(4)="[3"D"][3"A"][3"C"]B[3"D"][3
"A"][3"C"]B"                              IB
·9562 MV$(4)="5  4  5  45  4  5  4"       LG
·9569 REM PHRASE 5                        JC
·9570 MD$(5)="[9"1"]5[8"1"]8"             KK
·9571 ME$(5)="[3"D"][3"A"][3"C"]BD[s C]DE
DCBAG"                                    KG
·9572 MV$(5)="5  4  5  45[5" "]4  "       AI
·9898 REM CONVERT STRINGS TO USABLE FORM  IG
·9899 REM                                 JD
·9900 FOR PH=0 TO ES%                     EI
·9905 A$=ME$(PH):ME$(PH)=""               JB
·9910 FOR I=1 TO LEN(A$)                  OE
·9920 X%=ASC(MID$(A$,I,1))                IP
·9930 IF X%<72 THEN X%=X%-64:IF X%<0 THEN
 X%=0                                     ED
·9931 IF X%>192AND X%<200 THEN X%=X%-178  GP
·9932 IF X%=176 THEN X%=8                 IF
·9933 IF X%=191 THEN X%=9                 FN
·9934 IF X%=188 THEN X%=10                II
·9935 IF X%=172 THEN X%=11                IM
·9936 IF X%=177 THEN X%=12                LA
·9937 IF X%=187 THEN X%=13                IE
·9938 IF X%=165 THEN X%=14                HL
·9939 IF X%>21 THEN X%=0                  DL
·9940 V$=MID$(MV$(PH),I,1):IF V$<>" " THE
N Y%=21*VAL(V$)                           LJ
·9950 X%=X%+Y%                            MJ
·9970 ME$(PH)=ME$(PH)+CHR$(X%)            CP
·9975 NEXT:NEXT                           EF
·9980 PH=0                                HP
·9990 RETURN                              IM
```

BROKEN MELODY

```
·1 REM "BROKEN MELODY"                    JC
·2 REM THREE VOICES WAIT FOR USER INPUT B
ETWEEN PHRASES                            HL
·3 REM USE THIS ROUTINE FOR A SERIES OF R
EWARDS                                    NG
·4 REM                                    JD
·5 REM PLAYS "I'M ON MY WAY" (FROM "PAINT
 YOUR WAGON" BY LERNER & LOEWE)           MK
·6 REM                                    JD
·10 GOSUB 9000:GOTO 100                   LC
·60 FOR N=1 TO LEN(MD$(PH))               FJ
·61 FOR VC=0 TO EV%                       GG
·62 POKE GR(VC),UG%(VC):REM NORMAL NOTES;
 DON'T POKE UG% FOR LEGATO                AE
·63 FOR I=0 TO 1                          JB
·64 POKE FR(VC,I),PI%(ASC(MID$(ME$(PH,VC)
,N,1)),I)                                 BD
·65 NEXT:NEXT                             EF
·66 FOR VC=EV% TO 0 STEP -1:POKE GR(VC),G
%(VC):NEXT                                MB
·67 FOR I=0 TO DU%(VAL(MID$(MD$(PH),N,1))
):NEXT                                    JB
·68 REM FOR VC=0 TO EV%:POKE GR(VC),UG%(V
C):NEXT:REM STACCATO NOTES                BO
·69 NEXT:PH=PH+1:IF PH>ES% THEN PH=0      IJ
·70 FOR VC=0 TO EV%:POKE GR(VC),UG%(VC):N
EXT:RETURN                                EP
·100 PRINT "PRESS SHIFT FOR PHRASE "PH    JB
·110 PRINT "ANY OTHER KEY TO STOP"        LG
·120 IF PEEK(203)<>64 THEN END            DG
·130 IF PEEK(653)=0 THEN 120              GC
·140 GOSUB 60                             PC
·190 GOTO 100                             CF
·8997 REM                                 JD
·8998 REM SET UP SOUND SHAPE              FD
·8999 REM                                 JD
·9000 DIM MD$(23),ME$(23,2),MV$(23,2),G%(
```

```
2),GR(2),FR(2,1),AD(2)                      CF
•9001 DIM DU%(9),PI%(168,1),AK%(2),DY%(2)
 ,SN%(2),RE%(2),WF%(2)                      OF
•9007 REM                                   JD
•9008 REM ATTACK--VOICES 0,1,2              KG
•9009 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SHARPER ATTACK                          OK
•9010 AK%(0)=0:AK%(1)=0:AK%(2)=0            CP
•9015 FOR I=0 TO 2:AK%(I)=AK%(I)*16:NEXT    FF
•9017 REM                                   JD
•9018 REM DECAY--VOICES 0,1,2               PK
•9019 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=FASTER DECLINE                          GA
•9020 DY%(0)=7:DY%(1)=3:DY%(2)=3            AN
•9027 REM                                   JD
•9028 REM SUSTAIN--VOICES 0,1,2             FC
•9029 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SOFTER VOLUME DURING SUSTAIN            JM
•9030 SN%(0)=0:SN%(1)=0:SN%(2)=0            EG
•9035 FOR I=0 TO 2:SN%(I)=SN%(I)*16:NEXT    BD
•9037 REM                                   JD
•9038 REM RELEASE--VOICES 0,1,2             OK
•9039 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=FASTER DROP TO SILENCE AT END           PJ
•9040 RE%(0)=0:RE%(1)=3:RE%(2)=5            BG
•9047 REM                                   JD
•9048 REM SET SOUND ADDRESSES               JC
•9049 REM                                   JD
•9050 FR(0,0)=54272:FR(1,0)=54279:FR(2,0)
 =54286                                     PG
•9055 FOR I=0 TO 2:FR(I,1)=1+FR(I,0):GR(I
 )=FR(I,0)+4:AD(I)=GR(I)+1:NEXT             HJ
•9057 REM                                   JD
•9058 REM POKE ADSR ENVELOPES               JL
•9059 REM                                   JD
•9060 FOR I=0 TO 2:POKE AD(I),AT%(I) OR D
 Y%(I)                                      EN
•9065 POKE AD(I)+1,SN%(I) OR RE%(I):NEXT    DK
•9066 REM                                   JD
•9067 REM SET UP GATES                      JN
•9068 REM WAVEFORMS, VOICES 0,1,2 (ADD VA
 LUES):                                     DJ
•9069 REM TRIANGLE ON=16; SAWTOOTH ON=32;
  PULSE ON=64 (SET WIDTH!); NOISE ON=128    IL
•9070 WF%(0)=32:WF%(1)=64:WF%(2)=64         LH
•9075 FOR I=0 TO 2:G%(I)=1 OR WF%(I):UG%(
 I)=G%(I)AND 254:NEXT                       AB
•9077 REM                                   JD
•9078 REM SET PULSE WIDTHS                  AC
•9079 REM VOICES 0,1,2; LOW BYTE, HIGH BY
 TE                                         MG
•9080 POKE GR(0)-2,200:POKE GR(0)-1,3       JD
•9081 POKE GR(1)-2,200:POKE GR(1)-1,3       LD
•9082 POKE GR(2)-2,200:POKE GR(2)-1,3       EP
•9096 REM                                   JD
•9097 REM SET UP PITCH ARRAY                DK
•9098 REM EACH NOTE, IN ALL ITS OCTAVES     JB
•9099 REM C                                 NE
•9100 X%=3:GOSUB 9190                       BK
•9101 DATA 12,1,24,2,48,4,97,8,195,16,135
 ,33,15,67,30,134                           IF
•9102 REM D                                 NH
•9103 X%=4:GOSUB 9190                       PH
•9104 DATA 45,1,90,2,180,4,104,9,209,18,1
 62,37,69,75,139,150                        PA
•9105 REM E (F-FLAT)                        MH
•9106 X%=5:GOSUB 9190:Y%=13:GOSUB 9195      DN
•9107 DATA 81,1,163,2,71,5,143,10,31,21,6
 2,42,125,84,250,168                        HM
•9108 REM F (E-SHARP)                       DB
•9109 X%=6:GOSUB 9190:Y%=19:GOSUB 9195      GE
•9110 DATA 102,1,204,2,152,5,48,11,96,22,
 193,44,131,89,6,179                        IL
•9111 REM G                                 NI
•9112 X%=7:GOSUB 9190                       AO
•9113 DATA 145,1,35,3,71,6,143,12,30,25,6
 0,50,121,100,243,200                       GM
•9114 REM A                                 NC
•9115 X%=1:GOSUB 9190                       PA
•9116 DATA 195,1,134,3,12,7,24,14,49,28,9
 9,56,199,112,143,225                       PI
•9117 REM B                                 NF
•9118 X%=2:GOSUB 9190                       PF
•9119 DATA 250,1,244,3,233,7,210,15,165,3
 1,75,63,151,126,46,253                     CF
•9120 REM D-FLAT (C-SHARP)                  JL
•9121 X%=11:GOSUB 9190:Y%=17:GOSUB 9195     NN
•9122 DATA 28,1,56,2,112,4,225,8,195,17,1
 34,35,12,71,24,142                         KJ
•9123 REM E-FLAT (D-SHARP)                  FD
•9124 X%=12:GOSUB 9190:Y%=18:GOSUB 9195     LD
•9125 DATA 62,1,125,2,251,4,247,9,239,19,
 223,39,191,79,126,159                      FB
•9126 REM G-FLAT (F-SHARP)                  HH
•9127 X%=14:GOSUB 9190:Y%=20:GOSUB 9195     HK
•9128 DATA 123,1,246,2,237,5,218,11,181,2
 3,107,47,214,94,172,189                    HG
•9129 REM A-FLAT (G-SHARP)                  HE
•9130 X%=8:GOSUB 9190:Y%=21:GOSUB 9195      GN
•9131 DATA 169,1,83,3,167,6,78,13,156,26,
 57,53,115,106,230,212                      PA
•9132 REM B-FLAT (A-SHARP)                  FP
•9133 X%=9:GOSUB 9190:Y%=15:GOSUB 9195      DD
•9134 DATA 221,1,187,3,119,7,239,14,223,2
 9,190,59,124,119,248,238                   CN
•9135 REM C-FLAT                            CH
•9136 X%=10:GOSUB 9190                      DL
•9137 DATA 4,1,250,1,244,3,233,7,210,15,1
 65,31,75,63,151,126                        AK
•9138 REM B-SHARP                           IN
•9139 X%=16:GOSUB 9190                      CJ
•9140 DATA 24,2,48,4,97,8,195,16,135,33,1
 5,67,30,134,255,255                        NM
•9185 GOTO 9200                             FM
•9189 REM READ PITCHES                      NA
•9190 FOR I=0 TO 147 STEP 21:READ PI%(I+X
```

```
%,0),PI%(I+X%,1):NEXT:RETURN               FN
·9194 REM IDENTICAL PITCHES                GA
·9195 FOR I=0 TO 147 STEP 21:PI%(I+Y%,0)=
 PI%(I+X%,0):PI%(I+Y%,1)=PI%(I+X%,1)       LN
·9196 NEXT:RETURN                          EJ
·9197 REM                                  JD
·9198 REM SET UP DURATIONS                 ME
·9199 REM                                  JD
·9200 FOR I=0 TO 9:READ DU%(I):NEXT        MB
·9205 DATA 10,128,256,384,512,640,768,102
 4,1152,1280                               KF
·9296 REM                                  JD
·9297 REM SET FILTER AND VOLUME            BN
·9298 REM FILTER FREQUENCY                 DE
·9299 REM LOW BYTE (0-7) X%; HIGH BYTE (0
 -255) Y%                                  PA
·9300 X%=0:Y%=100                          GD
·9305 POKE 54293,X%:POKE 54294,Y%          KJ
·9308 REM FILTER ON?                       DD
·9309 REM VOICE 1 ON=1; 2 ON=2; 3 ON=4; 1
 &2 ON=3; 2&3 ON=6; ALL ON=7               AL
·9310 X%=0                                 FM
·9318 REM FILTER RESONANCE                 CE
·9319 REM PEAK VOLUME (0=LOW, 15=HIGH)     FH
·9320 Y%=14                                JL
·9325 Y%=Y%*16:POKE 54295,X% OR Y%         MG
·9328 REM SELECT FILTER TYPE               CP
·9329 REM LOW-PASS=1;BAND-PASS=2;HIGH-PAS
 S=4;LO-BAND=3;HI-BAND=6;ALL=7             MH
·9330 X%=1                                 FP
·9335 X%=X%*16                             LC
·9337 REM                                  JD
·9338 REM SELECT OVERALL VOLUME            FJ
·9339 REM 15=HIGH, 0=LOW                   PB
·9340 Y%=15                                JK
·9345 POKE 54296,X% OR Y%                  HN
·9496 REM                                  JD
·9497 REM SET MELODIES HERE                PA
·9498 REM                                  JD
·9499 REM HOW MANY VOICES? (MINUS ONE)     GN
·9500 EV%=2                                KA
·9508 REM                                  JD
·9509 REM HOW MANY PHRASES? (MINUS ONE)    MA
·9510 ES%=8                                KH
·9514 REM                                  JD
·9515 REM MELODY STRINGS                   JJ
·9516 REM                                  JD
·9517 REM EACH PHRASE HAS ONLY ONE DU%(PH
 ) STRING, NO MATTER HOW MANY VOICES       AO
·9518 REM EACH PHRASE HAS ONE ME$(PH,VC)
 & ONE MV$(PH,VC) STRING PER VOICE         IP
·9519 REM PHRASE 0                         IP
·9520 MD$(0)="[16"0"]"                     LE
·9521 ME$(0,0)="[3"F"]GAFG@[3"F"]GAFGE"    AD
·9522 MV$(0,0)="6[15" "]"                  KK
·9523 ME$(0,1)="CCDCGD[4"C"]DCGDCC"        JN
·9524 MV$(0,1)="4545354545453545"          PG
·9525 ME$(0,2)="FAEAGBC[c B]FADAGBC[c B]"  NH
·9526 MV$(0,2)="3434343434343434"          GH
·9529 REM PHRASE 1                         IO
·9530 MD$(1)="[16"0"]"                     KL
·9531 ME$(1,0)="[3"F"]GAFGEF[7"@"]"        OL
·9532 MV$(1,0)="6[15" "]"                  NL
·9533 ME$(1,1)="FCECDBCCFCECDACA"          PJ
·9534 MV$(1,1)="45454  545454  5"          JH
·9535 ME$(1,2)="FAEADBC[c B]FAEADFCF"      CM
·9536 MV$(1,2)="3434343434343435"          DH
·9539 REM PHRASE 2                         JB
·9540 MD$(2)="[16"0"]"                     LC
·9541 ME$(2,0)="[3"[c B]"]CD[c B]C@[3"[c
 B]"]CD[c B]CA"                            IL
·9542 MV$(2,0)="6  7 67 6  7 676"          GM
·9543 ME$(2,1)="@F@FCGFF@F@FCGFF"          MD
·9544 MV$(2,1)=" 5  4545[4" "]4545"        HE
·9545 ME$(2,2)="[c B]DGDCEF[c E][c B]DGDC
 EF[c E]"                                  KA
·9546 MV$(2,2)="3535353535353535"          KB
·9549 REM PHRASE 3                         JA
·9550 MD$(3)="[14"0"]"                     CM
·9551 ME$(3,0)="[3"[c B]"]CD[c B]CA[c B][
 5"@"]"                                    MC
·9552 MV$(3,0)="6  7 676[6" "]"            MA
·9553 ME$(3,1)="[c B]FAFGEFF[c B]FAFGF"    JM
·9554 MV$(3,1)="45454545454545"            LF
·9555 ME$(3,2)="[c B]DADGCF[c E][c B]DADG
 D"                                        MA
·9556 MV$(3,2)="35353535353535"            NJ
·9559 REM PHRASE 4                         JD
·9560 MD$(4)="[16"0"]"                     DA
·9561 ME$(4,0)="F[c B]C@C[3"@"]D[c B]C[5"
 @"]"                                      PF
·9562 MV$(4,0)="6 7[6" "]67[5" "]"         CF
·9563 ME$(4,1)="[3"F"]AG[c B]AADGFAG[c B]
 AA"                                       NK
·9564 MV$(4,1)="45454545 4 54545"          LH
·9565 ME$(4,2)="FDFFGEAF[c B][3"F"]GEAF"   JH
·9566 MV$(4,2)="3535353534353535"          DK
·9569 REM PHRASE 5                         JC
·9570 MD$(5)="[18"0"]"                     AO
·9571 ME$(5,0)="CFG@G@@GAFG[7"@"]"         EC
·9572 MV$(5,0)="6[17" "]"                  OG
·9573 ME$(5,1)="@BGEGFGE@BFECCAFGC"        MA
·9574 MV$(5,1)=" 4 54545 4 5453[3" "]"     NN
·9575 ME$(5,2)="@AECDBECGACFC[c B]AFGF"    BI
·9576 MV$(5,2)=" 4 54  534343 2  1"        MA
·9579 REM PHRASE 6                         JF
·9580 MD$(6)="[16"0"]"                     NO
·9581 ME$(6,0)="[3"F"]GAFG@[3"F"]GAFGE"    OB
·9582 MV$(6,0)="6[15" "]"                  NA
·9583 ME$(6,1)="CCDCGD[4"C"]DCGDCC"        KD
·9584 MV$(6,1)="4545354545453545"          EM
·9585 ME$(6,2)="FAEAGBC[c B]FADAGBC[c B]"  ON
·9586 MV$(6,2)="3434343434343434"          FF
·9589 REM PHRASE 7                         JE
·9590 MD$(7)="[15"0"]"                     IE
·9591 ME$(7,0)="[3"F"]GAFGEC[3"@"]C@@"     IG
```

```
•9592 MV$(7,0)="6[11" "]7  "                 LF
•9593 ME$(7,1)="FCECDBCC@A@[c B]CF@"         BP
•9594 MV$(7,1)="45454  5 4  5  "             AL
•9595 ME$(7,2)="FAEADBC[c B]FFGRA[c E]@"     MK
•9596 MV$(7,2)="34343434343435 "             LM
•9599 REM PHRASE 8                           JH
•9600 MD$(8)="[17"0"]"                       EG
•9601 ME$(8,0)="DC@C[c B]AFGDF[3"@"]F[3"@
 "]"                                         KN
•9602 MV$(8,0)="7[3" "]6[8" "]7[3" "]"       BN
•9603 ME$(8,1)="[c B]CACA@C@CFDC[c B]A@F@
 "                                           CL
•9604 MV$(8,1)="5[8" "]46 5  4 "             CA
•9605 ME$(8,2)="DCFCFCAC[c B]F[c B]AGF@F@
 "                                           EB
•9606 MV$(8,2)="545354 3435[4" "]3 "         JH
•9897 REM                                    JD
•9898 REM CONVERT STRINGS TO USABLE FORM     IG
•9899 REM                                    JD
•9900 FOR PH=0 TO ES%:FOR VC=0 TO EV%        AH
•9905 A$=ME$(PH,VC):ME$(PH,VC)=""            EC
•9910 FOR I=1 TO LEN(A$)                     OE
•9920 X%=ASC(MID$(A$,I,1))                   IP
•9930 IF X%<72 THEN X%=X%-64:IF X%<0 THEN
 X%=0                                        ED
•9931 IF X%>192AND X%<200 THEN X%=X%-178     GP
•9932 IF X%=176 THEN X%=8                    IF
•9933 IF X%=191 THEN X%=9                    FN
•9934 IF X%=188 THEN X%=10                   II
•9935 IF X%=172 THEN X%=11                   IM
•9936 IF X%=177 THEN X%=12                   LA
•9937 IF X%=187 THEN X%=13                   IE
•9938 IF X%=165 THEN X%=14                   HL
•9939 IF X%>21 THEN X%=0                     DL
•9950 V$=MID$(MV$(PH,VC),I,1):IF V$<>" "
 THEN Y%=21*VAL(V$)                          PG
•9960 IF X%<>0 THEN X%=X%+Y%                 CK
•9970 ME$(PH,VC)=ME$(PH,VC)+CHR$(X%)         OC
•9975 NEXT:NEXT:NEXT                         PI
•9980 PH=0                                   HP
•9990 RETURN                                 IM
```

QUAD-PRINT

FROM PAGE 47

MENU

```
•5 PRINT"[CLEAR][DOWN][RVSON][BLACK] QUAD
 PRINT (C) 1984 BY MICHAEL BEUTJER "         AH
•10 POKE55,0:POKE56,28                       CE
•20 PRINT"[3"[DOWN]"][WHITE]SELECT YOUR P
RINTER TYPE.[DOWN][DOWN]"                    PN
•30 PRINT"PRESS F1 FOR EPSON RX/FX 80 OR
100."                                        PH
•40 PRINT"[DOWN]PRESS F3 FOR COMMODORE 15
26."                                         PE
•50 GETA$:IFA$=""THEN50                      FO
•60 IFASC(A$)=133THENB$="QP E*":PRINT"[CL
EAR][10"[DOWN]"][6" "]LOADING EPSON/GEMI
NI VERSION"                                  CL
•70 IFASC(A$)=134THENB$="QP C*":PRINT"[CL
EAR][10"[DOWN]"][5" "]LOADING COMMODORE
1526 VERSION"                                NL
•75 IFB$=""THEN50                            PN
•80 POKE53280,6:POKE53281,14:PRINT"[HOME]
[c 7][3"[DOWN]"]LOAD"CHR$(34)B$CHR$(34)"
,8"                                          FO
•90 PRINT"[HOME]":POKE198,5:FORX=0TO4:REA
DA:POKE631+X,A:NEXT:END                      CO
•500 DATA13,31,82,213,13                     GO
```

1526 VERSION

```
•5 PRINT"[CLEAR][4"[DOWN]"][8" "]INITIALI
ZING[3"."]"                                  CE
•10 GOSUB570                                 CM
•20 POKE53280,0:POKE53281,0:POKE646,15:PR
INT"[CLEAR][DOWN][DOWN][12" "]QUAD-PRINT
 1526"                                       EF
•30 DIMB$(4):PRINT"[DOWN][9" "](C) 1984 B
Y M. BEUTJER"                                KK
•40 IFB=0THENB=1:GOTO70                      MM
•50 PRINT"[CLEAR][DOWN] PIC 1 (UPPER LEFT
 ) : "B$(1):PRINT" PIC 2 (UPPER RIGHT) :
 "B$(2)                                      MF
•60 PRINT" PIC 3 (LOWER LEFT ) : "B$(3):P
RINT" PIC 4 (LOWER RIGHT) : "B$(4)           EP
•70 PRINT"[DOWN][RIGHT][RVSON]  F1 = DISP
LAY 1 [RVSOFF][5" "][RVSON]  F2 = LOAD 1
[3" "]"                                      NN
•80 PRINT"[DOWN][RIGHT][RVSON]  F3 = DISP
LAY 2 [RVSOFF][5" "][RVSON]  F4 = LOAD 2
[3" "]"                                      FJ
•90 PRINT"[DOWN][RIGHT][RVSON]  F5 = DISP
LAY 3 [RVSOFF][5" "][RVSON]  F6 = LOAD 3
[3" "]"                                      PB
•100 PRINT"[DOWN][RIGHT][RVSON]  F7 = DIS
PLAY 4 [RVSOFF][5" "][RVSON]  F8 = LOAD
4[3" "]"                                     CF
•110 PRINT"[DOWN][RIGHT][RVSON]  [EP]  =
DUMP POS  [RVSOFF][5" "][RVSON]  [BACKAR
ROW]  = DUMP NEG "                           DM
•120 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
"]*  = QUICK VIEW SCREENS "                  OC
•130 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
"]@  = SWAP SCREENS[7" "]"                   HI
•140 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
"][UPARROW]  = SINGLE PRINT[7" "][DOWN]"     IK
•150 GETA$:IFA$<>""THEN150                   AO
•160 GETA$:IFA$=""THEN160                    HK
•170 A=ASC(A$)                               GE
•180 IFA=92THENSYS49209:GOTO40               EG
•190 IFA=95THENSYS49205:GOTO40               GL
•200 IFA=42THENA=1:GOSUB540:SYS49430:SYS4
9188:GOTO300                                 BD
```

```
·210 IFA=64THEN330                              CL
·220 IFA=94THEN550                              DI
·230 IFA<133THEN160                             EE
·240 IFA>140THEN160                             FK
·250 A=A-132:IFA>4THENGOSUB460:GOTO40           IB
·260 GOSUB540:SYS49430:SYS49188                 MC
·270 GETA$:IFA$<>""THEN270                      DB
·280 GETA$:IFA$=""THEN280                       HJ
·290 SYS49188:GOTO40                            OB
·300 GETA$:A=ASC(A$+CHR$(0)):IFA=32THENSY
S49188:GOTO40                                   HO
·310 IFA<133ORA>136THEN300                      MB
·320 A=A-132:GOSUB540:SYS49430:GOTO300          BI
·330 PRINT"ENTER THE NUMBERS OF THE SCREE
NS"                                             JB
·340 PRINT"YOU WANT TO SWAP (1-4)."             NL
·350 INPUT"1ST SCREEN : ";A                     IC
·360 INPUT"2ND SCREEN : ";B                     HP
·370 IFA<1ORA>4ORB<1ORB>4THEN330                IJ
·380 GOSUB540:SYS49430                          AJ
·390 POKE49153,16*(2+A*2):POKE49152,16*(2
+B*2)                                           AN
·400 POKE49155,224+(B-1)*4:POKE49154,224+
(A-1)*4                                         LK
·410 SYS49430                                   JI
·420 POKE49152,32:POKE49153,16*(2+B*2):PO
KE49155,224+(A-1)*4:POKE49154,4                 JE
·430 SYS49430                                   JI
·440 A$=B$(A):B$(A)=B$(B):B$(B)=A$              JG
·450 GOTO40                                     PE
·460 REM  GET FILENAME AND LOAD IT.             NO
·470 A=A-4:PRINT" ENTER FILENAME OF PIC"A
": ";:INPUTA$                                   AB
·480 IFLEN(A$)>16THEN470                        JM
·490 B$(A)=A$                                   AE
·500 POKE49156,LEN(A$):POKE49152,32:POKE4
9153,16*(2+A*2)                                 OF
·520 FORX=1TOLEN(A$):POKE49156+X,ASC(MID$
(A$,X,1)):NEXT                                  NF
·530 SYS49394:POKE49155,224+(A-1)*4:POKE4
9154,28:SYS49430:RETURN                         NB
·540 POKE49153,32:POKE49152,16*(2+A*2):PO
KE49154,224+(A-1)*4:POKE49155,4:RETURN          MC
·550 INPUT"ENTER NO. OF PICTURE TO PRINT
(1-4) : ";A                                     NB
·555 PRINT"PRESS P FOR POSITIVE, N FOR NE
GATIVE "                                        DO
·560 GETA$:IFA$<"N"ORA$>"P"THEN560              CF
·562 P=49788:IFA$="P"THENP=49792                DF
·565 POKE49152,16*(2+A*2):SYSP:GOTO40           PB
·570 I=49152                                    AJ
·580 READ A:IF A=256 THEN RETURN                HN
·590 POKE I,A:I=I+1:GOTO580                     CD
·600 DATA 0,0,0,0,0,60,162,0                    OH
·610 DATA 32,126,197,169,76,44,169,96           LH
·620 DATA 133,138,169,44,133,0,0,0              MD
·630 DATA 0,0,0,0,0,0,0,0                       FG
·640 DATA 0,0,0,0,173,17,208,73                 II
·650 DATA 32,141,17,208,173,24,208,73           IK
·660 DATA 8,141,24,208,96,169,255,208           NP
·670 DATA 2,169,0,141,33,192,32,117             ND
·680 DATA 193,169,0,133,251,169,64,133          EM
·690 DATA 252,169,0,141,32,192,169,96           KH
·700 DATA 141,31,192,169,25,141,29,192          HJ
·710 DATA 32,121,192,169,0,133,251,169          DD
·720 DATA 128,133,252,169,0,141,32,192          DH
·730 DATA 169,160,141,31,192,169,25,141         GD
·740 DATA 29,192,32,121,192,32,45,194           IA
·750 DATA 96,32,197,193,32,178,192,165          OI
·760 DATA 251,72,165,252,72,173,32,192          CE
·770 DATA 133,251,173,31,192,133,252,32         PE
·780 DATA 178,192,165,251,141,32,192,165        HF
·790 DATA 252,141,31,192,104,133,252,104        PH
·800 DATA 133,251,32,225,255,208,5,104          DG
·810 DATA 104,76,117,192,206,29,192,208         LP
·820 DATA 200,96,169,40,141,30,192,160          EM
·830 DATA 0,162,0,120,169,46,133,1              LJ
·840 DATA 177,251,141,34,192,169,47,133         PH
·850 DATA 1,88,14,34,192,62,21,192              LJ
·860 DATA 232,224,8,208,245,200,192,8           EE
·870 DATA 208,223,24,165,251,105,8,133          HJ
·880 DATA 251,165,252,105,0,133,252,162         DN
·890 DATA 0,32,219,193,206,30,192,208           HL
·900 DATA 198,96,169,1,162,8,160,0              ED
·910 DATA 32,186,255,173,4,192,162,5            JD
·920 DATA 160,192,32,189,255,169,0,170          LP
·930 DATA 160,28,32,213,255,169,1,32            DO
·940 DATA 195,255,32,204,255,96,160,0           JC
·950 DATA 132,251,174,1,192,134,252,132         OJ
·960 DATA 253,174,0,192,134,254,142,34          FG
·970 DATA 192,238,34,192,200,192,32,208         NA
·980 DATA 248,160,0,120,169,46,133,1            FE
·990 DATA 177,253,145,251,169,47,133,1          GD
·1000 DATA 88,200,208,239,230,252,230,254       LG
·1010 DATA 165,254,205,34,192,208,228,173       EE
·1020 DATA 3,192,133,252,173,2,192,133          AB
·1030 DATA 254,162,4,120,169,40,133,1           HP
·1040 DATA 177,253,145,251,200,208,249,23
0                                               GL
·1050 DATA 252,230,254,202,208,242,169,47       GG
·1060 DATA 133,1,88,96,0,169,4,170              MB
·1070 DATA 160,255,32,186,255,169,0,32          IA
·1080 DATA 189,255,32,192,255,176,40,169        NE
·1090 DATA 6,168,162,4,32,186,255,169           KI
·1100 DATA 0,32,189,255,32,192,255,176          PK
·1110 DATA 22,169,5,168,162,4,32,186            AK
·1120 DATA 255,169,0,32,189,255,32,192          EG
·1130 DATA 255,176,4,32,176,193,24,96           CB
·1140 DATA 162,6,32,201,255,169,21,32           KH
·1150 DATA 210,255,169,13,32,210,255,32         FL
·1160 DATA 174,255,32,204,255,162,4,32          DD
·1170 DATA 201,255,169,13,32,210,255,32         DJ
·1180 DATA 174,255,32,204,255,169,0,141         DO
·1190 DATA 116,193,96,32,93,194,240,105         KC
·1200 DATA 162,4,32,201,255,169,141,32          FK
·1210 DATA 210,255,32,174,255,32,204,255        DM
```

```
•1220 DATA 162,5,32,201,255,162,0,189      AH
•1230 DATA 21,192,77,33,192,32,210,255     LN
•1240 DATA 232,224,8,208,242,32,174,255    NN
•1250 DATA 162,4,32,201,255,174,116,193    JJ
•1260 DATA 240,9,169,32,32,210,255,202     FE
•1270 DATA 76,16,194,238,116,193,169,254   DI
•1280 DATA 32,210,255,32,174,255,32,204    GJ
•1290 DATA 255,32,109,194,96,32,197,193    IE
•1300 DATA 162,6,32,201,255,169,24,32      MC
•1310 DATA 210,255,169,13,32,210,255,32    FL
•1320 DATA 174,255,32,204,255,32,231,255   MJ
•1330 DATA 96,162,4,32,201,255,169,254     OJ
•1340 DATA 32,210,255,32,174,255,32,204    GJ
•1350 DATA 255,238,116,193,96,162,0,189    CP
•1360 DATA 21,192,221,123,194,208,5,232    PP
•1370 DATA 224,8,208,243,96,162,0,189      FF
•1380 DATA 21,192,157,123,194,232,224,8    JC
•1390 DATA 208,245,96,0,169,255,208,2      MO
•1400 DATA 169,0,141,33,192,32,117,193     LH
•1410 DATA 169,0,133,251,173,0,192,133     LB
•1420 DATA 252,169,25,141,29,192,32,197    OM
•1430 DATA 193,32,178,192,32,225,255,208   CH
•1440 DATA 3,76,169,194,206,29,192,208     IN
•1450 DATA 237,32,45,194,96,256            NF
```

EPSON/GEMINI VERSION

Program as listed is for Epson printers. See introductory article for changes required for Gemini printers.

```
•5 PRINT"[CLEAR][4"[DOWN]"][8" "]INITIALI
 ZING[3"."]"                               CE
•10 GOSUB540                               DB
•20 POKE53280,0:POKE53281,0:POKE646,15:PR
 INT"[CLEAR][DOWN][DOWN][14" "]QUAD-PRINT
 "                                         NE
•30 DIMB$(4):PRINT"[DOWN][9" "](C) 1984 B
 Y M. BEUTJER"                             KK
•40 IFB=0THENB=1:GOTO70                    MM
•50 PRINT"[CLEAR][DOWN] PIC 1 (UPPER LEFT
  ) : "B$(1):PRINT" PIC 2 (UPPER RIGHT) :
  "B$(2)                                   MF
•60 PRINT" PIC 3 (LOWER LEFT ) : "B$(3):P
 RINT" PIC 4 (LOWER RIGHT) : "B$(4)        EP
•70 PRINT"[DOWN][RIGHT][RVSON]  F1 = DISP
 LAY 1 [RVSOFF][5" "][RVSON]  F2 = LOAD 1
 [3" "]"                                   NN
•80 PRINT"[DOWN][RIGHT][RVSON]  F3 = DISP
 LAY 2 [RVSOFF][5" "][RVSON]  F4 = LOAD 2
 [3" "]"                                   FJ
•90 PRINT"[DOWN][RIGHT][RVSON]  F5 = DISP
 LAY 3 [RVSOFF][5" "][RVSON]  F6 = LOAD 3
 [3" "]"                                   PB
•100 PRINT"[DOWN][RIGHT][RVSON]  F7 = DIS
 PLAY 4 [RVSOFF][5" "][RVSON]  F8 = LOAD
 4[3" "]"                                  CF
•110 PRINT"[DOWN][RIGHT][RVSON]  [EP]  =
 DUMP POS  [RVSOFF][5" "][RVSON]  [BACKAR
 ROW]  = DUMP NEG "                        DM
•120 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
 "]*  = QUICK VIEW SCREENS "               OC
•130 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
 "]@  = SWAP SCREENS[7" "][DOWN]"          GL
•140 GETA$:IFA$<>""THEN140                 AL
•150 GETA$:IFA$=""THEN150                  HN
•160 A=ASC(A$)                             GE
•170 IFA=92THENSYS49209:GOTO40             EG
•180 IFA=95THENSYS49205:GOTO40             GL
•190 IFA=42THENA=1:GOSUB520:SYS49490:SYS4
 9188:GOTO280                              FO
•200 IFA=64THEN310                         CF
•210 IFA<133THEN150                        EH
•220 IFA>140THEN150                        FN
•230 A=A-132:IFA>4THENGOSUB440:GOTO40      FD
•240 GOSUB520:SYS49490:SYS49188            AK
•250 GETA$:IFA$<>""THEN250                 CP
•260 GETA$:IFA$=""THEN260                  HH
•270 SYS49188:GOTO40                       OB
•280 GETA$:A=ASC(A$+CHR$(0)):IFA=32THENSY
 S49188:GOTO40                             HO
•290 IFA<133ORA>136THEN280                 LI
•300 A=A-132:GOSUB520:SYS49490:GOTO280     NP
•310 PRINT"ENTER THE NUMBERS OF THE SCREE
 NS"                                       JB
•320 PRINT"YOU WANT TO SWAP (1-4)."        NL
•330 INPUT"1ST SCREEN : ";A                IC
•340 INPUT"2ND SCREEN : ";B                HP
•350 IFA<1ORA>4ORB<1ORB>4THEN310           ID
•360 GOSUB520:SYS49490                     AB
•370 POKE49153,16*(2+A*2):POKE49152,16*(2
 +B*2)                                     AN
•380 POKE49155,224+(B-1)*4:POKE49154,224+
 (A-1)*4                                   LK
•390 SYS49490                              KG
•400 POKE49152,32:POKE49153,16*(2+B*2):PO
 KE49155,224+(A-1)*4:POKE49154,4           JE
•410 SYS49490                              KG
•420 A$=B$(A):B$(A)=B$(B):B$(B)=A$         JG
•430 GOTO40                                PE
•440 REM  GET FILENAME AND LOAD IT.        NO
•450 A=A-4:PRINT" ENTER FILENAME OF PIC"A
 ": ";:INPUTA$                             AB
•460 IFLEN(A$)>16THEN450                   JO
•470 B$(A)=A$                              AE
•480 POKE49156,LEN(A$):POKE49152,32:POKE4
 9153,16*(2+A*2)                           OF
•500 FORX=1TOLEN(A$):POKE49156+X,ASC(MID$
 (A$,X,1)):NEXT                            NF
•510 SYS49454:POKE49155,224+(A-1)*4:POKE4
 9154,28:SYS49490:RETURN                   JO
•520 POKE49153,32:POKE49152,16*(2+A*2):PO
 KE49154,224+(A-1)*4:POKE49155,4:RETURN    MC
•530 REM      POKE IN ML ROUTINE           DB
•540 I=49152                               AJ
•550 READA:IFA=256THEN565                  KA
•560 SUM=SUM+A:POKE I,A:I=I+1:GOTO550      EE
•565 IFSUM<>61145THENPRINT"ERROR IN DATA
 STATEMENTS.":END:REM SUM=61166 FOR 10X    BF
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
•566 RETURN                                IM
•570 DATA 0,0,0,0,0,60,162,0               OH
•580 DATA 32,126,197,169,76,44,169,96      LH
•590 DATA 133,138,169,44,133,0,0,0         MD
•600 DATA 0,0,0,0,0,0,0,0                  FG
•610 DATA 0,0,0,0,173,17,208,73            II
•620 DATA 32,141,17,208,173,24,208,73      IK
•630 DATA 8,141,24,208,96,169,255,208      NP
•640 DATA 2,169,0,141,33,192,169,4         IF
•650 DATA 162,4,160,0,32,186,255,169       MM
•660 DATA 0,32,189,255,32,192,255,162      PJ
•670 DATA 4,32,201,255,169,0,133,251       CD
•680 DATA 169,64,133,252,169,0,141,32      NH
•690 DATA 192,169,96,141,31,192,162,210    BI
•700 DATA 32,176,193,32,210,255,169,25     BE
•710 DATA 141,29,192,32,163,192,169,0      NM
•720 DATA 133,251,169,128,133,252,169,0    PD
•730 DATA 141,32,192,169,160,141,31,192    DL
•740 DATA 169,25,141,29,192,32,163,192     MM
•750 DATA 169,27,32,210,255,169,64,32      JI
•760 DATA 210,255,169,4,32,195,255,32      MM
•770 DATA 204,255,96,162,200,32,176,193    AN
•780 DATA 32,227,192,165,251,72,165,252    IH
•790 DATA 72,173,32,192,133,251,173,31     OE
•800 DATA 192,133,252,32,227,192,165,251   JA
•810 DATA 141,32,192,165,252,141,31,192    DL
•820 DATA 104,133,252,104,133,251,169,13   GJ
•830 DATA 32,210,255,32,225,255,208,5      CF
•840 DATA 104,104,76,144,192,206,29,192    IA
•850 DATA 208,193,96,169,40,141,30,192     CE
•860 DATA 160,0,162,0,120,169,46,133       NM
•870 DATA 1,177,251,141,34,192,169,47      JO
•880 DATA 133,1,88,14,34,192,62,21         IM
•890 DATA 192,232,224,8,208,245,200,192    MB
•900 DATA 8,208,223,24,165,251,105,8       CN
•910 DATA 133,251,165,252,105,0,133,252    FL
•920 DATA 162,0,189,21,192,77,33,192       OO
•930 DATA 32,210,255,232,224,8,208,242     BE
•940 DATA 206,30,192,208,187,96,169,1      PJ
•950 DATA 162,8,160,0,32,186,255,173       LJ
•960 DATA 4,192,162,5,160,192,32,189       MM
•970 DATA 255,169,0,170,160,28,32,213      PC
•980 DATA 255,169,1,32,195,255,32,204      PE
•990 DATA 255,96,160,0,132,251,174,1       JB
•1000 DATA 192,134,252,132,253,174,0,192   BI
•1010 DATA 134,254,142,34,192,238,34,192   JG
•1020 DATA 200,192,32,208,248,160,0,120    HC
•1030 DATA 169,46,133,1,177,253,145,251    NI
•1040 DATA 169,47,133,1,88,200,208,239     JP
•1050 DATA 230,252,230,254,165,254,205,34  AL
•1060 DATA 192,208,228,173,3,192,133,252   NH
•1070 DATA 173,2,192,133,254,162,4,120     NL
•1080 DATA 169,40,133,1,177,253,145,251    OC
•1090 DATA 200,208,249,230,252,230,254,20
 2                                         EB
•1100 DATA 208,242,169,47,133,1,88,96      PE
•1110 DATA 142,188,193,142,195,193,160,0   DC
•1120 DATA 162,0,232,189,200,193,32,210    JM
•1130 DATA 255,138,217,200,193,48,243,96   DK
•1135 REM                                  JD
•1136 REM                                  JD
•1137 REM   PRINTER CONTROL CODES          FH
•1138 REM                                  JD
•1139 REM                                  JD
•1140 REM *  EPSON PRINTER MODULE  *       LG
•1150 DATA 5,27,42,6,128,2,0,0,0,0         CJ
•1160 DATA 3,27,65,8,0,0,0,256             GK
•1170 REM *  GEMINI PRINTER MODULE  *      JE
•1180 DATA 4,27,76,128,2,0,0,0,0,0         HD
•1190 DATA 3,27,51,16,0,0,0,256            LL
```

6510 SIMULATOR

FROM PAGE 77

```
•100 REM ******* 6510 SIMULATOR ********   BD
•110 DATA ASL,BRK,CLC,CLD,CLI,CLV,DEX,DEY
 ,INX,INY,LSR,NOP,PHA,PHP,PLA               IL
•120 DATA PLP,ROL,ROR,RTI,RTS,SEC,SED,SEI
 ,TAX,TAY,TSX,TXA,TXS,TYA                   LO
•130 DATA ADC,AND,CMP,CPX,CPY,EOR,LDA,LDX
 ,LDY,ORA,SBC                               FG
•140 DATA ADC,AND,ASL,BCC,BCS,BEQ,BIT,BMI
 ,BNE,BPL,BVC,BVS,CMP,CPX,CPY               EC
•150 DATA DEC,EOR,INC,JMP,JSR,LDA,LDX,LDY
 ,LSR,ORA,ROL,ROR,SBC,STA,STX               FC
•160 DATA STY,ASL,LSR,ROL,ROR               LJ
•170 DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F BK
•180 DATA 0000,0001,0010,0011,0100,0101,0
 110,0111                                   PG
•190 DATA 1000,1001,1010,1011,1100,1101,1
 110,1111                                   GG
•200 DIM HEX$(8),BIT$(8),H$(16),B$(16),TE
 MP$(2),BIT(8),N$(75)                       NC
•210 AH$="00":XH$="00":YH$="00":Z$="0":AD
 =0:SC=0:YD=0                               AL
•220 AB$="[8"0"]":XB$="[8"0"]":YB$="[8"0"
 ]"                                         GF
•230 N=0:V=0:B=0:D=0:I=0:Z=0:C=0            NN
•240 IF RIGHT$(A$,1)=" "THEN 300:REM TYPE
  A SPACE BETWEEN THE QUOTES                PD
•250 FOR L=1 TO 75:READ N$(L):NEXT L        MA
•260 FOR L=1 TO 16:READ H$(L):NEXT L:FOR
 L=1 TO 16:READ B$(L):NEXT L                CH
•270 PRINT CHR$(147):REM CLEAR SCREEN       EG
•280 PRINT " N  V  -  B  D  I  Z  C"        NF
•285 PRINT N;V;" - ";B;D;I;Z;C:PRINT        LA
•290 PRINT "A: ";AH$;"[7" "]X: ";XH$;"[7"
 "]Y: ";YH$                                 KM
•295 PRINT AB$;"[4" "]";XB$;"[4" "]";YB$:
 PRINT                                      OB
•300 B=0:A$="":INPUT " ";A$:REM TYPE SPAC
 E BETWEEN SECOND PAIR OF QUOTES            MG
```

```
320 IF LEN(A$)<3 OR LEN(A$)>10 THEN 300  CD
330 IF LEN(A$)=3 THEN 420:REM GO TO IMPL
 IED-ADDRESS ROUTINES                    JC
340 IF MID$(A$,4,1)<>CHR$(32) THEN 300   AJ
350 IF RIGHT$(A$,1)=CHR$(32) THEN 300    PC
360 GOTO 450:REM GO TO IMMEDIATE- AND AB
 SOLUTE-ADDRESS ROUTINES                 BH
370 REM *** ROUTINE TO CONVERT OP$ & AD$
 TO BINARY NUMBERS ***                   LP
380 OD$=OP$:GOSUB 1130:FOR L=1 TO 8:BIT$
(L)=Z$:NEXT L                            AG
390 FOR L=1 TO 8:B1$(L)=MID$(OB$,L,1):NE
XT L                                     EC
400 FOR L=1 TO 8:B2$(L)=MID$(AB$,L,1):NE
XT L:RETURN                              OI
410 REM *** IMPLIED-ADDRESSING ROUTINES
***                                      JL
420 FOR L=1 TO 29:IF A$=N$(L) THEN OC$=A
$:OC=L:GOTO  1350                        LN
430 NEXT L:GOTO 300                      CH
440 REM *** IMMEDIATE, ABSOLUTE & ACCUMU
LATOR ADDRESS MODES ***                  CP
450 OC$=LEFT$(A$,3):OP$=MID$(A$,5)       NC
460 IF LEFT$(OP$,1)="#" AND MID$(OP$,2,1
)="$" THEN  FLAG$="AH":GOTO  530         KH
470 IF LEFT$(OP$,1)="#" THEN FLAG$="AD":
GOTO 620                                 IG
480 IF LEFT$(OP$,1)="$" THEN FLAG$="IH":
GOTO 690                                 OK
490 IF OP$="A" THEN 790                  MN
500 IF LEFT$(OP$,1)<"0" AND LEFT$(OP$,1)
>"9" THEN 300:REM TRY AGAIN              JO
510 FLAG$="ID":GOTO 840                  CB
520 REM *** HEX OPERAND, ABSOLUTE ADDRES
S ***                                    FI
530 OP$=MID$(OP$,3)                      MH
540 FOR L=30 TO 40:IF OC$=N$(L) THEN OC=
L:GOTO 560                               GP
550 NEXT L:GOTO 300                      CH
560 IF  LEN(OP$)>2 THEN 300              JP
570 FOR L=1 TO  LEN(OP$):X$=MID$(OP$,L,1
):IF X$<Z$ OR X$>"F" THEN 300            PC
580 IF X$>"9"AND X$<"A" THEN 300         AI
590 IF LEN(OP$)=1 THEN OP$=Z$+OP$        JH
600 OH$=OP$:GOSUB 1030:OP$=OD$:GOTO 670  IN
610 REM *** DECIMAL OPERAND, ABSOLUTE AD
DRESSING ***                             GN
620 OP$=MID$(OP$,2)                      MG
630 FOR L=30TO 40:IF OC$=N$(L) THEN OC=L
:GOTO 650                                GB
640 NEXT L:GOTO 300                      CH
650 IF VAL(OP$)>255 THEN 300             OK
660 FOR  L=1 TO LEN(OP$):X$=MID$(OP$,L,1
):IFASC(X$)<48 OR ASC(X$)>57 THEN 420    EH
670 OC=OC-29:GOTO 1420                   HK
680 REM *** HEX OPERAND, IMMEDIATE ADDRE
SS ***                                   EA
690 OP$=MID$(OP$,2)                      MG
700 FOR  L=41 TO 71:IF OC$=N$(L) THEN OC
=L:GOTO720                               CN
710 NEXT L:GOTO 300                      CH
720 IF LEN(OP$)>4  THEN 300              KF
730 FOR L=1 TO LEN(OP$):X$=MID$(OP$,L,1)
:IF X$<Z$ OR X$>"F" THEN 300             PC
740 IF X$>"9" AND X$<"A" THEN 300        AI
750 NEXT L                               MO
760 OH$=OP$:GOSUB 1030:OP$=OD$:OP$=STR$(
PEEK(VAL(OP$)))                          JF
770 OC=OC-40:GOTO 1430                   IA
780 REM *** ACCUMULATOR ADDRESSING ***   EG
790 OP$="A"                              AL
800 FOR L=72 TO75:IF OC$=N$(L) THEN OC=L
-71: GOTO 820                            OI
810 NEXT L:GOTO 300                      CH
820 ON OC GOTO 1510,1760,1790,1810       IL
830 REM *** DECIMAL OPERAND, IMMEDIATE A
DDRESS **                                JC
840 IF VAL(OP$)>65535 THEN 300           JD
860 FOR L=1 TO LEN(OP$):X$=MID$(OP$,L,1)
:IF ASC(X$)<48 OR ASC(X$)>57 THEN 300    EI
870 FOR L=41 TO 71:IF OC$=N$(L) THEN OC=
L:GOTO 890                               CP
880 NEXT L:GOTO 300                      CH
890 OP$=STR$(PEEK(VAL(OP$)))             IN
900 OC=OC-40:GOTO 1430                   IA
910 REM *** DECIMAL-TO-HEXADECIMAL CONVE
RSION ***                                JN
920 FOR L=1 TO 4:HEX$(L)="":NEXT L       KJ
930 FOR L=1 TO 5:T$=RIGHT$(OD$,L):NEXT L HO
940 NR=VAL(OD$):X=4                      KF
950 TMP=NR:NR=INT(NR/16):TMP=TMP-NR*16   DM
960 IF TMP<10 THEN HEX$(X)=RIGHT$(STR$(T
MP),1):GOTO 980                          BN
970 HEX$(X)=CHR$(TMP-10+ASC("A"))        EA
980 IF NR<>0 THEN X=X-1:GOTO 950         PN
990 OH$=HEX$(1)+HEX$(2)+HEX$(3)+HEX$(4)  JM
1000 IF LEN(OH$)=1 THEN OH$=Z$+OH$       BP
1010 RETURN                              IM
1020 REM *** HEXADECIMAL-TO-DECIMAL CONV
ERSION ***                               GB
1030 NR=0:FOR L=1 TO LEN(OH$):HEX$(L)=MI
D$(OH$,L,1)                              FF
1040 IF HEX$(L)<="9" THEN NR=NR*16+VAL(H
EX$(L)):GOTO 1060                        GO
1050 NR=NR*16+ASC(HEX$(L))-ASC("A")+10   CE
1060 NEXT L:OD$=STR$(NR):RETURN          OK
1070 REM *** BINARY-TO-DECIMAL CONVERSIO
N ***                                    FC
1080 FOR L=8 TO 1 STEP -1:B$(L)=MID$(OB$
,L,1):NEXT L                             AL
1090 FOR L=1 TO 8:BIT(L)=VAL(B$(L)):NEXT
 L:OD=0:NR=256                           NL
1100 FOR  L=1 TO8:NR=NR/2:OD=OD+BIT(L)*N
R:NEXT L                                 GF
1110 OD$=STR$(OD):RETURN                 NO
1120 REM *** DECIMAL-TO-BINARY CONVERSIO
```

```
N ***                                       DG
•1130 OD=VAL(OP$):FOR L=8 TO 1 STEP -1:TM
P=OD/2:NR=TMP-INT(TMP)                      EL
•1140 IF NR=0 THEN BT$(L)=Z$:GOTO 1160      JO
•1150 BT$(L)="1"                            JE
•1160 OD=INT(TMP):NEXT L                    BP
•1170 OB$=BT$(1)+BT$(2)+BT$(3)+BT$(4)+BT$
(5)+BT$(6)+BT$(7)+BT$(8):RETURN             DN
•1180 REM *** HEX-TO-BINARY CONVERSION **
*                                           AI
•1190 HEX$(1)="":HEX$(2)="":FOR L=1 TOLEN
 (OH$):HEX$(L)=MID$(OH$,L,1)                DK
•1200 NEXT L:IF HEX$(2)="" THEN HEX$(2)=H
EX$(1):HEX$(1)=Z$                           OM
•1210 FOR L=1 TO 16:IF HEX$(1)=H$(L) THEN
 BIT$(1)=B$(L)                              HC
•1220 NEXT L:FOR L=1 TO 16:IF HEX$(2)=H$(
L) THEN BIT$(2)=B$(L)                       IG
•1240 NEXT L:OB$=BIT$(1)+BIT$(2):PRINT:RE
TURN                                        AP
•1260 REM *** BINARY-TO-HEX CONVERSION **
*                                           HA
•1270 FOR L=1 TO 8:BIT$(L)=MID$(OB$,L,1):
NEXT L                                      MM
•1280 BIT$=BIT$(1)+BIT$(2)+BIT$(3)+BIT$(4
)+BIT$(5)+BIT$(6)+BIT$(7)+BIT$(8)           PA
•1290 T1$=LEFT$(BIT$,4):T2$=RIGHT$(BIT$,4
):FOR L=1 TO 16                             NM
•1300 IF T1$=B$(L)THEN HEX$(1)=H$(L)        IL
•1310 NEXT L:FOR L=1 TO 16:IF T2$=B$(L) T
HEN HEX$(2)=H$(L)                           NK
•1320 NEXT L:IF HEX$(1)="" THEN HEX$(1)=Z
$                                           FG
•1330 OH$=HEX$(1)+HEX$(2):RETURN            CO
•1340 REM *** ON/GOTO DATA ***              LE
•1350 ON OC GOTO 1510,1560,1570,1580,1590
,1600,1610,1650,1690,1730                   JB
•1360 NR=OC-10:ON NR GOTO 1760,1780,1780,
1780,1780,1780,1790,1810,1830,1840          KG
•1380 NR=NR-10:ON NR GOTO 1850,1860,1870,
1880,1900,1920,1930,1940,1950,1840          CF
•1400 NR=NR-10:ON NR GOTO 1850,1860,1870,
1880,1900,1920,1930,1940,1950,1950          BP
•1420 ON OC GOTO 1970,2100,2170,2250,2320
,2390,2450,2550,2650,2750,2810              BD
•1430 ON OC GOTO 1970,2350,3250,1780,1780
,1780,3200,1780,1780,1780                   JO
•1440 NR=OC-10:ON NR GOTO 1780,1780,3250,
2250,2320,3260,2390,3290,1780,1780          EL
•1460 NR=NR-10:ON NR GOTO 2450,2550,2650,
3320,2750,3340,3360,2810,1780,1780          OL
•1480 NR=NR-10:ON NR GOTO 1780,3390         BB
•1500 REM *** IMPLIED-ADDRESS OP-CODE ROU
TINES                                       CG
•1510 C=VAL(LEFT$(AB$,1)):AB$=MID$(AB$,2)
+Z$:REM *** ASL ***                         EH
•1520 OB$=AB$:GOSUB 1270:AH$=OH$:OP$=OH$:
GOSUB 1030:N=0:Z=0                          DF
•1530 IF LEFT$(OB$,1)="1"THEN N=1           OP
•1540 IF VAL(OD$)=0THEN Z=1                 BO
•1550 GOTO 3390                             FK
•1560 B=1:GOTO 3390:REM *** BRK ***         JG
•1570 C=0:GOTO 3390:REM *** CLC ***         EL
•1580 D=0:GOTO 3390:REM *** CLD ***         FJ
•1590 I=0:GOTO 3390:REM *** CLI ***         IH
•1600 V=0:GOTO 3390:REM *** CLV ***         NN
•1610 OH$=XH$:GOSUB 1030:XD=VAL(OD$):REM
*** DEX **                                  IF
•1620 XD=XD-1:IF XD<0 THEN XD=255           JO
•1630 OD$=STR$(XD):GOSUB920:XH$=OH$:GOSUB
 1190:XB$=OB$                               BF
•1640 TMP=XD:GOSUB 3410:GOTO 280            EF
•1650 OH$=YH$:GOSUB 1030:YD=VAL(OD$):REM
*** DEY ***                                 OO
•1660 YD=YD-1:IF YD<0 THEN YD=255           BC
•1670 OD$=STR$(YD):GOSUB 920:YH$=OH$:GOSU
B 1190:YB$=OB$                              KK
•1680 TMP=YD:GOSUB 3410:GOTO 280            FE
•1690 OH$=XH$:GOSUB 1030:XD=VAL(OD$):REM
*** INX ***                                 BD
•1700 OD$=STR$(XD):GOSUB 920:XH$=OH$:GOSU
B 1190:XB$=OB$                              BF
•1710 XD=XD+1:IF XD>255 THEN XD=0           KP
•1720 GOTO 1630                             FN
•1730 OH$=YH$:GOSUB 1030:YD=VAL(OD$):REM
*** INY ***                                 CO
•1740 YD=YD+1:IF YD>255 THEN YD=0           NB
•1750 GOTO 1670                             FJ
•1760 C=VAL(RIGHT$(AB$,1)):AB$=Z$+LEFT$(A
B$,7):REM *** LSR ***                       OO
•1770 GOTO 1520                             FN
•1780 GOTO 3390:REM *** NOP,PHA,PHP,PLA A
ND PLP ***                                  OP
•1790 GOTO 3340:REM *** ROL ***             AC
•1810 GOTO 3360:REM *** ROR ***             EC
•1830 N=0:V=0:B=0:D=0:I=0:Z=0:C=0:GOTO 28
0 REM *** RTI ***                           ND
•1840 GOT 3390:REM *** RTS ***              LG
•1850 C=1:GOTO 3390:REM *** SEC ***         ID
•1860 D=1:GOTO 3390;REM *** SED ***         HG
•1870 I=1:GOTO 3390:REM *** SEI ***         GP
•1880 XH$=AH$:XB$=AB$:OP$=AH$:GOSUB 1030:
TMP=VAL(OD$):REM *** TAX ***                CG
•1890 GOSUB 3410:GOTO 3390                  PI
•1900 YH$=AH$:YB$=AB$:OP$=AH$:GOSUB 1030:
TMP=VAL(OD$):REM *** TAY ***                CN
•1910 GOSUB 3410:GOTO 3390                  PI
•1920 XH$="00":XB$="[8"0"]":GOSUB 3410:GO
TO 3390:REM *** TSX ***                     LN
•1930 AH$=XH$:AB$=XB$:GOTO 1520:REM *** T
XA ***                                      AO
•1940 GOTO 3390:REM *** TXS ***             DL
•1950 AH$=YH$:AB$=YB$:GOTO 1520:REM *** T
YA ***                                      HP
•1960 REM *** ABSOLUTE-ADDRESS OPERANDS *
**                                          FI
```

```
•1970 IF D THEN 2950:REM *** ADC ***          NJ
•1980 OP=VAL(OP$):TMP$=AB$                    OM
•1990 GOSUB 1130:PLUS$=OB$                    HA
•2000 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
 D$):TMP=AD                                   NF
•2010 AD=AD+OP+C:C=0:IF AD>255 THEN GOSUB
  2090                                        DK
•2020 AD$=STR$(AD):OD$=AD$:GOSUB920:AH$=O
 H$                                           BL
•2030 GOSUB 1190:AB$=OB$                      JK
•2040 N=0:IF AD>127 THEN N=1                  NO
•2050 Z=0:IF AD=0 THEN Z=1                    FC
•2060 V=0                                     DL
•2070 IF LEFT$(TMP$,1)=LEFT$(PLUS$,1) AND
  LEFT$(TMP$,1)<>LEFT$(AB$,1)THEN V=1         LN
•2080 OD$=AD$:GOSUB 1030:AH$=OH$:GOTO 280 DC
•2090 C=1:AD=AD-256:RETURN                    DP
•2100 GOSUB 380:REM *** AND ***               PJ
•2110 FOR L=1 TO 8:BIT$(L)="0":NEXT L         AA
•2120 FOR L=1 TO 8:IF B1$(L)="1" AND B2$(
 L)="1" THEN BIT$(L)="1"                      HJ
•2130 NEXT L                                  MO
•2140 AB$=BIT$(1)+BIT$(2)+BIT$(3)+BIT$(4)
 +BIT$(5)+BIT$(6)+BIT$(7)+BIT$(8)             LC
•2150 OB$=AB$:GOSUB 1270:AH$=OH$              LN
•2160 GOSUB 1030:TMP=VAL(OD$):GOSUB3410:P
 RINT:GOTO 280                                KC
•2170 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
 D$):OP=VAL(OP$):REM *** CMP ***              NB
•2180 Z=0:IF AD=OP THEN Z=1                   NN
•2190 N=0:IF OP>AD THEN N=1                   NA
•2220 C=0:IF  AD>OP OR AD=OP THEN C=1         CN
•2240 GOTO 3390                               FK
•2250 OH$=XH$:GOSUB 1030:XD$=OD$:XD=VAL(X
 D$):OP=VAL(OP$):REM *** CPX ***              CG
•2260 Z=0:IF XD=OP THEN Z=1                   LK
•2280 N=0:IF OP>XD THEN N=1                   NL
•2300 C=0:IF XD>OP OR XD=OP THEN C=1          GF
•2310 GOTO 3380                               GD
•2320 OH$=YH$:GOSUB 1030:YD$=OD$:YD=VAL(Y
 D$):OP=VAL(OP$):REM *** CPY ***              CN
•2330 Z=0:IF YD=OP THEN Z=1                   NF
•2340 N=0:IF OP>YD THEN N=1                   NI
•2350 C=0:IF YD>OP OR YD=OP THEN C=1          FN
•2380 GOTO 3380                               GD
•2390 GOSUB 380:REM *** EOR ***               OG
•2400 FOR L=1 TO 8:BIT$(L)=Z$:NEXT L          PJ
•2410 FOR L=1 TO 8:IF B1$(L)="1" AND B2$(
 L)="1" THEN BIT$(L)="0":GOTO 2440            KO
•2420 IF B1$(L)="1" OR B2$(L)="1" THEN BI
 T$(L)="1"                                    FE
•2440 NEXT L:GOTO 2140                        FP
•2450 IF D=1 THEN 2480:REM *** LDA ***        LG
•2460 OD$=OP$:GOSUB 920:AH$=OH$:GOSUB 119
 0:AB$=OB$                                    IG
•2470 TMP=VAL(OP$):GOSUB 3410:GOTO 280        HA
•2480 IF FLAG$="AD" AND VAL(OP$)>99 THEN
 300                                          JD
•2490 IF FLAG$<>"AD" THEN OD$=OP$:GOSUB 9
 20:AH$=OH$:GOTO 2530                         MD
•2500 IF LEN(OP$)=1 THEN OP$=Z$+OP$           JH
•2510 AH$=OP$:OH$=AH$:GOTO 2530               NJ
•2520 OD$=OP$:GOSUB 920:AH$=OH$               EB
•2530 GOSUB 1190:AB$=OB$                      JK
•2540 TMP=VAL(OP$):GOSUB 3410:GOTO 2470       JN
•2550 IF D=1 THEN 2580:REM *** LDX ***        MM
•2560 OD$=OP$:GOSUB 920:XH$=OH$:GOSUB 119
 0:XB$=OB$                                    NO
•2570 TMP=VAL(OP$):GOSUB 3410:GOTO 280        HA
•2580 IF FLAG$="AD" AND VAL(OP$)>99 THEN
 300                                          JD
•2590 IF FLAG$<>"AD" THEN OD$=OP$:GOSUB 9
 20:XH$=OH$:GOTO 2630                         GN
•2600 IF LEN(OP$)=1 THEN OP$=Z$+OP$           JH
•2610 XH$=OP$:OH$=XH$:GOTO 2630               HA
•2620 OD$=OP$:GOSUB 920:XH$=OH$               CM
•2630 GOSUB 1190:XB$=OB$                      MF
•2640 TMP=VAL(OP$):GOSUB 3410:GOTO 2570       JK
•2650 IF D=1 THEN 2680:REM *** LDX ***        OJ
•2660 OD$=OP$:GOSUB 920:YH$=OH$:GOSUB 119
 0:YB$=OB$                                    JG
•2670 TMP=VAL(OP$):GOSUB 3410:GOTO 280        HA
•2680 IF FLAG$="AD" AND VAL(OP$)>99 THEN
 300                                          JD
•2690 IF FLAG$<>"AD" THEN OD$=OP$:GOSUB 9
 20:YH$=OH$:GOTO 2730                         PN
•2700 IF LEN(OP$)=1 THEN OP$=Z$+OP$           JH
•2710 YH$=OP$:OH$=YH$:GOTO 2730               EL
•2720 OD$=OP$:GOSUB 920:XH$=OH$               CM
•2730 GOSUB 1190:YB$=OB$                      OC
•2740 TMP=VAL(OP$):GOSUB 3410:GOTO 2670       JP
•2750 GOSUB 380:REM *** ORA ***               KE
•2760 FOR L=1 TO8:IF B1$(L)="1" OR B2$(L)
 ="1" THEN BIT$(L)="1"                        KC
•2770 NEXT L:AB$="":FOR L=1 TO 8:AB$=AB$+
 BIT$(L):NEXT L                               PE
•2790 OB$=AB$:GOSUB 1270:AH$=OH$              LN
•2800 GOSUB 1030:TMP=VAL(OD$):GOSUB3410:G
 OTO 3390                                     FB
•2810 IF D THEN 3060:REM *** SBC ***          NI
•2820 OP=VAL(OP$):TMP$=AB$                    OM
•2830 GOSUB 1130:MI$=OB$                      LJ
•2840 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
 D$):TMP=AD                                   NF
•2850 AD=AD-OP:IF C=0 THEN AD=AD-1            IN
•2860 IF AD<0 THEN AD=256+AD:C=0              AN
•2870 AD$=STR$(AD):OD$=AD$:GOSUB 920:AH$=
 OH$                                          BL
•2880 GOSUB 1190:AB$=OB$                      JK
•2890 N=0:IF AD>127 THEN N=1                  NO
•2900 Z=0:IF AD=0 THEN Z=1                    FC
•2910 V=0:IF LEFT$(TMP$,1)=LEFT$(MI$,1) T
 HEN 2930                                     EE
•2920 IF LEFT$(AB$,1)=LEFT$(TMP$,1) THEN
 V=1                                          HI
•2930 OD$=AD$:GOSUB 1030:AH$=OH$:GOTO 280 DC
```

TO ENTER *SCREEN MAGIC*...

You must use the *Flankspeed* program. See the instructions and listing for *Flankspeed* on page 86.

```
•2940 REM *** BCD ADDITION ROUTINE ***     AC
•2950 IF FLAG$<>"AD" THEN 1980             HP
•2960 IF LEFT$(AH$,1)>"9" OR RIGHT$(AH$,1
)>"9" THEN 3030                            CG
•2970 AD=VAL(AH$)                          PO
•2980 OP=VAL(OP$):AD=AD+OP+C:C=0           NE
•2990 GOSUB 1030:TMP=VAL(OD$):GOSUB 3410   HK
•3000 IF AD>99 THEN GOSUB 3040             EF
•3010 AH$=STR$(AD):IF LEN(AH$)=1 THEN AH$
=Z$+AH$                                    JN
•3020 OH$=AH$:GOSUB 1190:AB$=OB$:GOTO 280  ID
•3030 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
D$):GOTO 2980                              OF
•3040 C=1:AD=AD-100:RETURN                 CF
•3050 REM *** BCD SUBTRACTION ROUTINE ***  DL
•3060 IF FLAG$<>"AD" THEN 2820             HJ
•3070 IF LEFT$(AH$,1)>"9" OR RIGHT$(AH$,1
)>"9" THEN 3120                            GA
•3080 AD=VAL(AH$):OP=VAL(OP$):AD=AD-OP:IF
 C=0 THEN AD=AD-1                          LB
•3100 IF AD<0 THEN GOSUB 3130              OF
•3110 GOTO 3010                            EP
•3120 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
D$):GOTO 3090                              NI
•3130 C=0:AD=100+AD:RETURN                 CB
•3140 REM *** IMMEDIATE-ADDRESS ROUTINES
***                                        AN
•3150 OD$=OP$:GOSUB 920:GOSUB 1190:REM **
* ASL ***                                  CL
•3160 C=VAL(LEFT$(OB$,1)):OB$=MID$(OB$,2)
+Z$                                        AD
•3170 GOSUB 1270:GOSUB 1030:X=VAL(OD$):N=
0:IF X<0 THEN N=1                          GF
•3180 Z=0:IF X=0 THEN Z=1                  AC
•3190 GOTO 280                             CG
•3200 GOSUB 1030:AD=VAL(OD$):REM *** BIT
***                                        IJ
•3210 GOSUB 1130:N=VAL(LEFT$(OB$,1)):V=VA
L(MID$(OB$,2,1))                           IP
•3220 GOSUB 400:Z=1:FOR L=1 TO 8           HD
•3230 IF B1$(L)="1" AND B2$="1" THEN Z=0   HC
•3240 NEXT L:GOTO 3390                     FN
•3250 GOTO 2170                            FB
•3260 OP=VAL(OP$):OP=OP-1:IF OP<0 THEN N:
REM *** DEC ***                            EM
•3270 IF OP=0 THEN Z=1                     AC
•3280 GOTO 3390                            FK
•3290 OP=VAL(OP$):OP=OP+1:IF OP<0 THEN N=
1:REM *** INC ***                          NL
•3300 IF OP=Z THEN Z=1                     CA
•3310 GOTO 3390                            FK
•3320 OD$=OP$:GOSUB 920:GOSUB 1190         EC
•3330 C=VAL(RIGHT$(OB$,1)):OB$=Z$+LEFT$(O
B$,7):GOTO 3170                            DK
•3340 IF C=1 THEN J$="1":REM *** ROL ***   GF
•3341 IF C=0 THEN J$="0"                   PA
•3342 C=VAL(LEFT$(AB$,1)):AB$=RIGHT$(AB$,
7)+J$                                      BD
•3350 OB$=AB$:GOSUB 1270:AH$=OH$:OP$=OH$:
GOSUB 1030:N=0:Z=0                         DF
•3355 IF LEFT$(OB$,1)="1" THEN N=1         OP
•3356 IF VAL(OD$)=0THEN Z=1                BO
•3357 GOTO 3390                            FK
•3360 IF C=1 THEN J$="1":REM *** ROR ***   GH
•3365 IF C=0 THEN J$=Z$                    PL
•3370 C=VAL(RIGHT$(AB$,1)):AB$=J$+LEFT$(A
B$,7)                                      DL
•3371 GOTO 3350                            FO
•3380 REM *** PRINT LINE SPACE & GET ANOT
HER LINE ***                               FK
•3390 PRINT:GOTO 280                       PI
•3400 REM *** SET Z AND N FLAGS ***        HO
•3410 N=0:IF TMP>127 THEN N=1              EE
•3420 Z=0:IF TMP=0 THEN Z=1                MO
•3430 RETURN                               IM
```

SCREEN MAGIC

FROM PAGE 33

First byte: C000 Last byte: C8E7 SYS to Start: RUN

```
C000: A9 80 8D 8A 02 20 44 E5 8E
C008: A9 00 8D 21 D0 8D 15 D0 A4
C010: A9 0B 8D 20 D0 8D 86 02 59
C018: A0 08 A2 17 A9 12 20 D2 29
C020: FF 18 20 F0 FF A9 B4 20 C7
C028: D2 FF CA E0 FF D0 F2 20 8A
C030: 66 E5 A9 0D 8D EB C8 A9 1F
C038: C7 85 FE A9 C7 85 FF 20 9B
C040: 68 C0 20 68 C0 A9 D9 85 BB
C048: FE A9 C7 85 FF 20 68 C0 87
C050: 20 68 C0 A9 00 8D EB C8 85
C058: A9 EB 85 FE A9 C7 85 FF 69
C060: 20 68 C0 A0 00 4C 76 C0 CD
C068: A0 00 B1 FE 20 D2 FF C8 75
C070: CD EB C8 D0 F5 60 B9 AA 7E
C078: C7 99 C0 3E C8 C0 1D D0 50
C080: F5 A9 00 99 C0 3E C8 C0 42
C088: 40 D0 F8 A9 2E 8D 00 D0 C8
C090: A9 70 8D 01 D0 A9 07 8D 48
C098: 27 D0 A9 00 8D 10 D0 A9 52
C0A0: FB 8D F8 07 20 60 C3 A9 18
C0A8: 01 8D 15 D0 AD 00 DC C9 71
C0B0: 7F F0 F9 20 70 C3 AD 00 1D
C0B8: DC 49 FF 8D EB C8 29 10 5A
C0C0: C9 10 F0 6F AD EB C8 29 86
C0C8: 0F C9 01 F0 72 C9 02 F0 C2
C0D0: 6B C9 04 F0 64 C9 08 F0 22
C0D8: 5D 20 E4 FF C9 56 F0 62 AE
C0E0: C9 85 F0 76 C9 89 F0 75 51
C0E8: C9 86 F0 74 C9 8A F0 73 57
C0F0: C9 87 F0 51 C9 88 F0 5F 27
```

```
C0F8: C9 8C F0 58 C9 14 F0 48 AF
C100: C9 13 F0 47 C9 1D F0 2E 1B
C108: C9 9D F0 2D C9 91 F0 2F 09
C110: C9 11 F0 28 C9 39 F0 36 2E
C118: C9 20 F0 17 C9 93 F0 31 89
C120: C9 5F F0 42 C9 41 F0 49 C1
C128: C9 C1 F0 58 C9 58 F0 67 77
C130: 4C B6 C0 4C 82 C2 4C 0A DB
C138: C2 4C 46 C2 4C D4 C1 4C 7F
C140: B2 C1 4C 2E C5 4C 8F C3 94
C148: 4C A4 C3 4C EA C3 4C FC 41
C150: C3 4C 07 C4 4C 58 C4 4C E1
C158: C6 C4 4C 02 C6 4C 3B C6 47
C160: 4C 76 C6 4C C5 C6 AD 45 B5
C168: C7 49 01 8D 45 C7 4C B6 18
C170: C0 AD 44 C7 49 01 8D 44 07
C178: C7 F0 19 AD 41 C7 8D EE 7D
C180: C8 4C B6 C0 AD 43 C7 49 0F
C188: 01 8D 43 C7 F0 06 AD 27 ED
C190: D0 8D EF C8 4C B6 C0 20 8B
C198: 44 E5 A9 00 8D 15 D0 8D 6D
C1A0: 8A 02 A9 0E 8D 86 02 8D 88
C1A8: 20 D0 A9 06 8D 21 D0 20 E8
C1B0: 74 A4 A9 08 8D EA C8 20 DC
C1B8: 66 C3 CE 01 D0 CE EA C8 06
C1C0: AD EA C8 D0 F2 AD 01 D0 65
C1C8: C9 28 D0 05 A9 E8 8D 01 B1
C1D0: D0 4C B6 C0 AD 01 D0 C9 AE
C1D8: E8 F0 27 A9 08 8D EA C8 CC
C1E0: 20 66 C3 EE 01 D0 CE EA A5
C1E8: C8 AD EA C8 D0 F2 AD 01 85
C1F0: D0 C9 F0 D0 05 A9 30 8D B9
C1F8: 01 D0 A9 00 8D 1B D0 4C 3A
C200: B6 C0 A9 01 8D 1B D0 4C E7
C208: DB C1 A9 08 8D EA C8 20 B8
C210: 66 C3 EE 00 D0 AD 00 D0 78
C218: F0 12 CE EA C8 AD EA C8 FE
C220: D0 ED AD 00 D0 C9 56 F0 6E
C228: 0B 4C 43 C2 A9 01 8D 10 CD
C230: D0 4C 1A C2 AD 10 D0 F0 A9
C238: 0A A9 00 8D 10 D0 A9 5E 62
C240: 8D 00 D0 4C B6 C0 A9 08 14
C248: 8D EA C8 20 66 C3 CE 00 A2
C250: D0 AD 00 D0 F0 12 CE EA 5C
C258: C8 AD EA C8 D0 ED AD 00 EE
C260: D0 C9 0E F0 0B 4C 7F C2 93
C268: A9 00 8D 10 D0 4C 56 C2 E5
C270: AD 10 D0 D0 0A A9 01 8D 12
C278: 10 D0 A9 4E 8D 00 D0 4C FB
C280: B6 C0 20 07 C3 AD 10 D0 71
C288: D0 09 AD 00 D0 C9 56 F0 F1
C290: 1B 90 1C AD 41 C7 81 FE 8F
C298: AD 27 D0 81 FC AD 45 C7 77
C2A0: D0 42 AD 44 C7 D0 1F AD 0B
C2A8: 43 C7 D0 29 4C C4 C0 AD 2D
C2B0: 01 D0 C9 49 90 08 A1 FE CE
C2B8: 8D 41 C7 4C C4 C0 A1 FC BF
C2C0: 8D 27 D0 4C C4 C0 AC 41 06
C2C8: C7 AE EE C8 8E 41 C7 8C 1B
C2D0: EE C8 4C A7 C2 AC 27 D0 E3
C2D8: AE EF C8 8E 27 D0 8C EF 43
C2E0: C8 4C AC C2 AD 00 D0 C9 AD
C2E8: D6 B0 B7 AD 10 D0 D0 B2 3A
C2F0: AD F1 C8 69 18 38 E5 FE F7
C2F8: 0A A8 AD 41 C7 91 FE AD A0
C300: 27 D0 91 FC 4C A2 C2 38 70
C308: AD 01 D0 E9 30 4A 4A 4A 80
C310: 8D E7 C8 0A 0A 6D E7 C8 80
C318: A2 00 8E E7 C8 0A 0A 2E 3C
C320: E7 C8 0A 2E E7 C8 85 FE 3E
C328: 8D F1 C8 AD E7 C8 69 04 3C
C330: 85 FF AD 10 D0 8D E9 C8 84
C338: 38 AD 00 D0 E9 16 8D E8 65
C340: C8 AD E9 C8 E9 00 4A 6E 0C
C348: E8 C8 AD E8 C8 4A 4A 65 53
C350: FE 85 FE 85 FC A5 FF 69 65
C358: 00 85 FF 69 D4 85 FD 60 FF
C360: A0 C8 88 D0 FD 60 AE 42 72
C368: C7 20 60 C3 CA D0 FA 60 6B
C370: A0 28 A9 0B 99 BF DB A9 CC
C378: A0 99 BF 07 88 C0 00 D0 93
C380: F1 60 A2 18 18 20 F0 FF B6
C388: AD 27 D0 8D 86 02 60 EE 93
C390: 21 D0 AD 21 D0 29 0F C9 24
C398: 0B F0 03 4C B6 C0 EE 21 6B
C3A0: D0 4C B6 C0 20 07 C3 AD CD
C3A8: 10 D0 D0 09 AD 00 D0 C9 AB
C3B0: 5E F0 09 90 28 A9 20 81 0D
C3B8: FE 4C 46 C2 A9 56 8D 00 9A
C3C0: D0 A9 01 8D 10 D0 AD 01 59
C3C8: D0 69 07 C9 F0 F0 06 8D 49
C3D0: 01 D0 4C B5 C3 A9 30 8D CF
C3D8: 01 D0 4C B5 C3 A9 56 8D FD
C3E0: 00 D0 A9 01 8D 10 D0 4C 17
C3E8: 46 C2 A9 5E 8D 00 D0 A9 02
C3F0: 00 8D 10 D0 A9 30 8D 01 C7
C3F8: D0 4C B6 C0 AD 41 C7 69 AD
C400: 7F 8D 41 C7 4C B6 C0 A9 83
C408: 08 85 FE A9 04 85 FF A2 6A
C410: 17 A0 1F A9 20 91 FE 88 C9
C418: D0 F9 18 A5 FE 69 28 85 B6
C420: FE A5 FF 69 00 85 FF CA 7E
C428: E0 FF D0 E5 4C EA C3 E0 9B
C430: 40 F0 1F A9 00 8D 21 D0 A9
C438: A0 09 20 82 C3 A9 C7 85 3F
C440: FF A9 8E 85 FE A9 00 8D 34
C448: EB C8 20 68 C0 20 E4 FF 4B
C450: F0 FB 20 70 C3 4C B6 C0 55
C458: A0 09 20 82 C3 A9 C7 85 5F
C460: FF A9 5E 85 FE A9 00 8D 24
C468: EB C8 20 68 C0 A0 10 20 37
C470: 82 C3 20 76 C5 AD F2 C8 7C
C478: F0 43 A9 01 8D F0 C8 20 BE
C480: 5E C5 A2 01 20 C9 FF AD DF
C488: 21 D0 20 D2 FF 20 BD C5 11
C490: A2 18 A0 1F B1 FE 20 D2 AE
```

```
C498: FF B1 FC 20 D2 FF 88 D0 93
C4A0: F3 20 CC C5 CA D0 EB A9 78
C4A8: 01 20 C3 FF 20 CC FF A9 24
C4B0: 2E 8D 00 D0 A9 70 8D 01 E5
C4B8: D0 A6 90 D0 06 20 70 C3 EB
C4C0: 4C B6 C0 4C 2F C4 A0 09 6E
C4C8: 20 82 C3 A9 C7 85 FF A9 CF
C4D0: 76 85 FE A9 00 8D EB C8 B7
C4D8: 20 68 C0 A0 10 20 82 C3 39
C4E0: 20 76 C5 AD F2 C8 F0 D5 6D
C4E8: A9 00 8D F0 C8 20 5E C5 1E
C4F0: A2 01 20 C6 FF 20 E4 FF 80
C4F8: 8D 21 D0 20 BD C5 A9 18 DD
C500: 8D EC C8 A9 1F 8D ED C8 50
C508: 20 E4 FF AC ED C8 91 FE 01
C510: 20 E4 FF AC ED C8 91 FC 07
C518: CE ED C8 AD ED C8 D0 E8 BB
C520: 20 CC C5 CE EC C8 AD EC F1
C528: C8 D0 D8 4C A7 C4 A0 09 FC
C530: 20 82 C3 A0 00 B9 46 C7 FE
C538: C9 00 F0 07 20 D2 FF C8 B5
C540: 4C 35 C5 20 E4 FF C9 00 56
C548: F0 F9 C9 30 90 F5 C9 3A B7
C550: B0 F1 38 E9 2F 8D 42 C7 DB
C558: 20 70 C3 4C B6 C0 AD F2 11
C560: C8 A0 C8 A2 F3 20 BD FF 07
C568: A9 01 A2 08 AC F0 C8 20 44
C570: BA FF 20 C0 FF 60 A9 00 16
C578: 8D F2 C8 20 E4 FF F0 FB B3
C580: C9 0D F0 1C C9 14 F0 19 4C
C588: C9 20 90 EF C9 60 B0 EB B9
C590: AC F2 C8 99 F3 C8 20 D2 42
C598: FF EE F2 C8 C0 0F D0 DB BF
C5A0: 60 AD F2 C8 C9 00 F0 D3 F8
C5A8: A9 9D 20 D2 FF A9 20 20 CC
C5B0: D2 FF A9 9D 20 D2 FF CE 8C
C5B8: F2 C8 4C 7B C5 A9 08 85 39
C5C0: FE 85 FC A9 04 85 FF A9 1F
C5C8: D8 85 FD 60 18 A5 FE 69 AB
C5D0: 28 85 FE A5 FF 69 00 85 12
C5D8: FF 18 A5 FC 69 28 85 FC A7
C5E0: A5 FD 69 00 85 FD 60 38 0A
C5E8: A5 FE E9 28 85 FE A5 FF C9
C5F0: E9 00 85 FF 38 A5 FC E9 25
C5F8: 28 85 FC A5 FD E9 00 85 B6
C600: FD 60 20 BD C5 A2 18 A0 5D
C608: 1F B1 FE 8D EC C8 B1 FC C9
C610: 8D ED C8 88 B1 FE 8D EA 06
C618: C8 B1 FC C8 91 FC AD EA 7F
C620: C8 91 FE 88 88 D0 ED C8 12
C628: AD EC C8 91 FE AD ED C8 80
C630: 91 FC 20 CC C5 CA D0 CF DC
C638: 4C B6 C0 20 BD C5 A2 18 5A
C640: A0 01 B1 FE 8D EC C8 B1 87
C648: FC 8D ED C8 C8 B1 FE 8D 90
C650: EA C8 B1 FC 88 91 FC AD 77
C658: EA C8 91 FE C8 C8 C0 20 0F
C660: D0 EB 88 AD EC C8 91 FE 99
C668: AD ED C8 91 FC 20 CC C5 0E
C670: CA D0 CD 4C B6 C0 A0 1F 5D
C678: A2 17 A9 A0 85 FE 85 FC 83
C680: A9 07 85 FF A9 DB 85 FD BF
C688: B1 FE 8D EC C8 B1 FC 8D B8
C690: ED C8 20 E7 C5 B1 FE 8D 53
C698: E8 C8 B1 FC 8D E7 C8 20 57
C6A0: CC C5 AD E8 C8 91 FE AD D0
C6A8: E7 C8 91 FC 20 26 C7 CA C0
C6B0: D0 E3 20 CC C5 AD EC C8 7B
C6B8: 91 FE AD ED C8 91 FC 88 C4
C6C0: D0 B6 4C B6 C0 A0 1F A2 6E
C6C8: 01 20 BD C5 B1 FE 8D EC 98
C6D0: C8 B1 FC 8D ED C8 20 CC 79
C6D8: C5 B1 FE 8D E8 C8 B1 FC 3D
C6E0: 8D E7 C8 20 E7 C5 AD E8 83
C6E8: C8 91 FE AD E7 C8 91 FC 2F
C6F0: 20 0B C7 E8 E0 18 D0 E1 78
C6F8: 20 E7 C5 AD EC C8 91 FE BA
C700: AD ED C8 91 FC 88 D0 BF 0C
C708: 4C B6 C0 18 A5 FE 69 50 42
C710: 85 FE A5 FF 69 00 85 FF 29
C718: 18 A5 FC 69 50 85 FC A5 B4
C720: FD 69 00 85 FD 60 38 A5 49
C728: FE E9 50 85 FE A5 FF E9 75
C730: 00 85 FF 38 A5 FC E9 50 CA
C738: 85 FC A5 FD E9 00 85 FD CB
C740: 60 20 05 00 00 00 20 43 29
C748: 55 52 53 4F 52 20 56 45 A0
C750: 4C 4F 43 49 54 59 20 28 6E
C758: 30 2D 39 29 20 00 20 53 AB
C760: 41 56 45 3E 20 20 20 20 FB
C768: 20 20 20 20 20 20 20 20 69
C770: 20 20 20 20 20 00 20 4C 7D
C778: 4F 41 44 3E 20 20 20 20 0C
C780: 20 20 20 20 20 20 20 20 81
C788: 20 20 20 20 20 00 05 20 4E
C790: 3C 3C 3C 3C 3C 3C 20 44 5E
C798: 49 53 4B 20 45 52 52 4F D9
C7A0: 52 20 3E 3E 3E 3E 3E 3E 88
C7A8: 20 00 FF F0 00 C0 30 00 AA
C7B0: C0 30 00 C0 30 00 C0 30 83
C7B8: 00 C0 30 00 C0 30 00 C0 5B
C7C0: 30 00 C0 30 00 FF F0 12 E4
C7C8: 90 20 97 20 98 20 9B 20 A5
C7D0: 05 20 1F 20 9A 20 9F 20 AF
C7D8: 0D 12 99 20 1E 20 9E 20 AE
C7E0: 96 20 1C 20 9C 20 81 20 32
C7E8: 95 20 0D 97 D5 C9 12 D5 CA
C7F0: C9 92 B0 AE 12 B0 AE 0D 2B
C7F8: CA CB 12 CA CB 92 AD BD 36
C800: 12 AD BD 0D B3 B1 DD DB A9
C808: D6 C0 B2 AB 0D 12 B3 B1 82
C810: DD DB D6 C0 B2 AB 0D D1 9E
C818: D7 D8 D3 DA C1 40 2A 0D B0
C820: A3 B7 B8 12 A2 B9 AF A4 F6
C828: 20 0D A4 AF B9 A2 12 B8 D0
C830: B7 A3 20 0D A7 B6 12 A1 CA
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
C838: B5 B4 92 DC A8 20 0D 12 F9
C840: AA B6 92 A1 B5 B4 A6 D9 C0
C848: 12 D4 0D C5 C4 C6 D2 CE 2F
C850: CD C8 12 C7 0D 12 C5 C4 6A
C858: C6 D2 CE CD 92 C7 12 C8 C3
C860: 0D BA CC 12 BA CC BF 92 E0
C868: 2B D4 12 D9 0D D0 CF 12 14
C870: D0 CF 92 BF 2D 5B 5D 0D 56
C878: 12 A9 DF 92 AC BB 12 AC CD
C880: BB 92 3C 3E 0D DF A9 BC 9C
C888: BE 12 BC BE 92 28 29 0D C5
C890: 41 42 43 44 45 46 47 48 B6
C898: 0D 49 4A 4B 4C 4D 4E 4F BB
C8A0: 50 0D 51 52 53 54 55 56 F4
C8A8: 57 58 0D 59 5A 24 27 2E 92
C8B0: 23 30 31 0D 32 33 34 35 11
C8B8: 36 37 38 39 0D 12 20 20 F6
C8C0: 20 20 20 20 20 20 20 92 34
C8C8: 20 20 9A 53 43 52 45 45 17
C8D0: 4E 20 4D 41 47 49 43 20 C1
C8D8: 20 42 59 20 42 4F 42 20 A8
C8E0: 53 50 49 52 4B 4F 00 01 BB
```

DUCK SHOOT

FROM PAGE 35

```
•5 PRINTCHR$(142):HS=0:GOSUB1100:POKE5328
0,0                                        EK
•10 PRINT"[HOME][DOWN][DOWN]"SPC(8)"[c 6]
[s Q][WHITE][s W][c 6][s Q][WHITE][s W][
c 6][s Q][WHITE][s W][c 6][s Q][WHITE][s
 W][c 6][s Q][WHITE][s W][c 6][s Q][WHIT
E][s W][c 6][s Q][WHITE][s W][c 6][s Q][
WHITE][s W][c 6][s Q][WHITE][s W][c 6][s
 Q][WHITE][s W]
[c 6][s Q][WHITE][s W]"                    AE
•20 PRINTSPC(7)"[WHITE][s W][RVSON][YELLO
W][sEP][RVSOFF][20" "][RVSON][c *][RVSOF
F][c 6][s Q]"                              AC
•30 PRINTSPC(6)"[c 6][s Q][YELLOW][RVSON]
[sEP] [RVSOFF][20" "][RVSON] [c *][RVSOF
F][WHITE][s W]"                            LO
•40 PRINTSPC(5)"[WHITE][s W][YELLOW][RVSO
N][sEP]  [RVSOFF][20" "][RVSON]  [c *][R
VSOFF][c 6][s Q]"                          PO
•50 PRINTSPC(4)"[s Q][YELLOW][RVSON][sEP]
[3" "][RVSOFF][20" "][RVSON][3" "][c *][
RVSOFF][WHITE][s W]"                       BK
•60 PRINTSPC(4)"[WHITE][s W][YELLOW][RVSO
N][4" "][RVSOFF][20" "][RVSON][4" "][RVS
OFF][c 6][s Q]"                            LG
•70 PRINTSPC(4)"[s Q][YELLOW][RVSON][4" "
][RVSOFF][20" "][RVSON][4" "][RVSOFF][WH
ITE][s W]"                                 OI
•80 PRINTSPC(4)"[WHITE][s W][YELLOW][RVSO
N][4" "][RVSOFF][20" "][RVSON][4" "][RVS
OFF][c 6][s Q]"                            LG
•90 PRINTSPC(4)"[c 6][s Q][YELLOW][RVSON]
  [RVSOFF][sEP][22"[c T]"][c *][RVSON]
[RVSOFF][WHITE][s W]"                      KM
•100 PRINTSPC(4)"[WHITE][s W][YELLOW][sEP
][26"[c T]"][c *][c 6][s Q]"               DI
•110 PRINTSPC(5)"[WHITE][28"[s Z]"]"       IK
•120 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON][3" "][RVSOFF][WHITE][s Z][s Z][RED
][RVSON] [RVSOFF][WHITE][s Z][s Z][RED][
RVSON] [RVSOFF][WHITE][s Z][RED][RVSON][
4" "][RVSOFF][WHITE][s Z][RVSON][RED] [R
VSOFF][WHITE][s Z][s Z][RED][RVSON] [RVS
OFF][WHITE][s Z
][RED][RVSON][4" "][RVSOFF][WHITE][s Z][
s Z]"                                      GL
•130 PRINTSPC(5)"[WHITE][s Z][s Z][RVSON]
[RED] [RVSOFF][WHITE][s Z][s Z][RED][RVS
ON] [RVSOFF][WHITE][s Z][RED][RVSON] [RV
SOFF][WHITE][s Z][s Z][RVSON][RED] [RVSO
FF][WHITE][s Z][RVSON][RED] [RVSOFF][WHI
TE][4"[s Z]"][RVSON][RED] [RVSOFF][WHITE
][s Z][RED][RVS
ON] [RVSOFF][WHITE][s Z][s Z][RED][RVSON
] [RVSOFF][WHITE][5"[s Z]"]"               FE
•140 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON] [RVSOFF][WHITE][s Z][s Z][RED][RVS
ON] [WHITE][RVSOFF][s Z][RED][RVSON] [WH
ITE][RVSOFF][s Z][s Z][RED][RVSON] [WHIT
E][RVSOFF][s Z][RED][RVSON] [WHITE][RVSO
FF][4"[s Z]"][RED][RVSON]  [WHITE][RVSOF
F][3"[s Z]"][RE
D][RVSON][4" "][WHITE][RVSOFF][s Z][s Z]
"                                          JF
•150 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON] [WHITE][RVSOFF][s Z][s Z][RED][RVS
ON] [WHITE][RVSOFF][s Z][RED][RVSON] [WH
ITE][RVSOFF][s Z][s Z][RED][RVSON] [WHIT
E][RVSOFF][s Z][RED][RVSON] [WHITE][RVSO
FF][4"[s Z]"][RED][RVSON] [WHITE][RVSOFF
][s Z][RED][RVS
ON] [WHITE][RVSOFF][5"[s Z]"][RED][RVSON
] [RVSOFF][WHITE][s Z][s Z]"               MK
•160 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON][3" "][WHITE][RVSOFF][s Z][s Z][RED
][RVSON][4" "][WHITE][RVSOFF][s Z][RED][
RVSON][4" "][WHITE][RVSOFF][s Z][RED][RV
SON] [WHITE][RVSOFF][s Z][s Z][RED][RVSO
N] [WHITE][RVSOFF][s Z][RED][RVSON][4" "
][WHITE][RVSOFF
][s Z][s Z]"                               DH
•170 PRINTSPC(5)"[WHITE][28"[s Z]"]"       IK
•180 PRINTSPC(5)"[YELLOW][s O][4"[c T]"][
s P][CYAN]SHOOTING GALLERY[YELLOW][s O][
4"[c T]"][s P]"                            JO
•190 PRINTSPC(5)"[c G][4" "][s N][16"[c T
```

```
]"][s M][4" "][c M]"                        OI
•200 PRINTSPC(5)"[YELLOW][s L][3"[c @]"][
s N][RVSON][18" "][RVSOFF][s M][3"[c @]"
][s @]"                                     ON
•210 PRINTSPC(8)"[YELLOW][c M][RVSON][20"
[c U]"][RVSOFF][c G]"                       CM
•215 PRINTSPC(8)"[YELLOW][c M][RVSON][20"
 "][RVSOFF][c G]"                           OM
•220 FORD1=12288TO12350:READS1:POKED1,S1:
NEXT                                        JM
•230 FORD2=12352TO12414:READS2:POKED2,S2:
NEXT                                        DF
•240 FORD3=12416TO12478:READS3:POKED3,S3:
NEXT                                        PE
•250 V=53248:S=54272:POKEV+39,13:POKEV+40
,7:POKEV+21,3:POKES+24,15:POKES,220         IK
•255 M=56320:O=65520:SC=0:TG=0:B=0:R=0      BP
•260 POKES+1,68:POKES+5,15:POKES+6,215:PO
KES+7,120:POKES+8,100:POKES+12,15           KP
•270 POKES+13,215:P1=192:P2=193:P3=195:X1
=100:Y1=100:X2=70:H=2                       JO
•280 Y2=INT(RND(1)*40)+70:R=R+1:POKEV+21,
3:H=H+.4:IFH>33THENH=H-2.4                  GA
•285 FORX2=70TO255STEPH                     GE
•290 POKE2040,P1                            BD
•300 POKE2041,P2:P2=P2+1:IFP2>194THENP2=1
93                                          IC
•310 GOSUB500                               CN
•320 IFJV=1ORJV=5ORJV=9THENY1=Y1-4:IFY1<6
8THENY1=Y1+4                                HP
•330 IFJV=2ORJV=6ORJV=10THENY1=Y1+4:IFY1>
118THENY1=Y1-4                              NK
•340 IFJV=4ORJV=5ORJV=6THENX1=X1-4:IFX1<9
0THENX1=X1+4                                LL
•350 IFJV=8ORJV=9ORJV=10THENX1=X1+4:IFX1>
240THENX1=X1-4                              NO
•355 IFFR=0ANDPEEK(V+30)AND1=1THEN600       BO
•360 POKEV,X1:POKEV+1,Y1                    GE
•370 POKEV+2,X2:POKEV+3,Y2                  FL
•400 NEXTX2:IFR>3THENPOKEV+21,1:GOTO900     MP
•410 GOTO280                                CG
•500 JV=PEEK(M)                             LN
•510 FR=JVAND16                             AN
•520 JV=15-(JVAND15)                        GH
•530 RETURN                                 IM
•600 POKEV+21,1:POKES+4,129:POKES+4,128:R
=0                                          IK
•605 IFNOTPEEK(V+30)AND1=1THEN610           ME
•610 POKEV+2,70:POKEV+3,90                  OI
•630 SC=SC+1:IFSC=10ORSC=20ORSC=30ORSC=40
ORSC=50ORSC=60ORSC=70ORSC=80THEN700         OH
•650 GOTO280                                CG
•700 FORL=1TO10:W=0:Y=INT(RND(1)*12)+12:X
=INT(RND(1)*5)+5                            NB
•701 POKE783,PEEK(783)AND254:POKE781,X:PO
KE782,Y:SYSO:PRINT"[RED][s W]"              FE
•705 GOSUB500                               CN
•706 IFJV=1ORJV=5ORJV=9THENY1=Y1-4:IFY1<6
8THENY1=Y1+4                                HP
•707 IFJV=2ORJV=6ORJV=10THENY1=Y1+4:IFY1>
118THENY1=Y1-4                              NK
•708 IFJV=4ORJV=5ORJV=6THENX1=X1-4:IFX1<9
0THENX1=X1+4                                LL
•709 IFJV=8ORJV=9ORJV=10THENX1=X1+4:IFX1>
240THENX1=X1-4                              NO
•720 IFFR=0ANDPEEK(V+31)AND1=1THEN800       KP
•730 W=W+1                                  EF
•740 IFSC<40ANDW=30THENSYSO:PRINT" ":NEXT
L:PRINT" "                                  GA
•745 IFSC=>40ANDW=25THENSYSO:PRINT" ":NEX
TL:PRINT" "                                 OI
•750 POKEV,X1:POKEV+1,Y1                    GE
•760 IFL<11THEN705                          EB
•780 PRINT" ":GOTO280                       GN
•800 POKES+4,33:POKES+4,32:POKE783,PEEK(7
83)AND254:POKE781,X:POKE782,Y:SYSO:PRINT
" "                                         JA
•805 TG=TG+50                               AC
•810 IFNOTPEEK(V+31)AND1=1THENNEXTL         AP
•820 POKE783,PEEK(783)AND254:POKE781,X:PO
KE782,Y:SYSO:PRINT" ":GOTO280               OI
•900 POKEV+21,1:CS=SC*25+TG:PRINT"[HOME][
3"[DOWN]"]"SPC(14)"[CYAN]SCORE:"CS          LH
•905 IFCS>HSTHENHS=CS                       AE
•910 FORL=1TO10                             MO
•920 PRINT"[HOME][4"[DOWN]"]"SPC(14)"[c 8
][RVSON]GAME[RVSOFF][3" "][RVSON]OVER[RV
SOFF]":FORG=1TO50:NEXTG                     AE
•930 PRINT"[HOME][4"[DOWN]"]"SPC(14)"[c 8
]GAME[3" "]OVER":FORG=1TO50:NEXTG           BK
•940 NEXTL:PRINT"[HOME][8"[DOWN]"]"SPC(11
)"[WHITE]HIGH SCORE:"HS                     LF
•945 Y2=INT(RND(1)*25)+75                   MI
•950 FORX2=75TO255STEP5                     GA
•955 POKEV+2,X2:POKEV+3,Y2                  FL
•960 POKE2041,193                           DB
•970 IFA$=""THENPRINT"[HOME][6"[DOWN]"]"S
PC(9)"[WHITE]HIT ANY KEY TO START":FORG=
1TO50:NEXT                                  FD
•980 PRINT"[HOME][6"[DOWN]"]"SPC(9)"[PURP
LE]HIT ANY KEY TO START":FORG=1TO50:NEXT    LI
•985 POKE2041,194                           DA
•990 GETA$:IFA$=""THENGOTO1000              DI
•1000 IFA$<>""THEN1020                      AF
•1010 NEXTX2:GOTO945                        HG
•1020 PRINT"[HOME][3"[DOWN]"]"SPC(14)"[13
" "]"                                       DE
•1030 PRINT"[HOME][4"[DOWN]"]"SPC(14)"[11
" "]"                                       DE
•1040 PRINT"[HOME][6"[DOWN]"]"SPC(9)"[20"
 "]"                                        JK
•1045 PRINT"[HOME][8"[DOWN]"]"SPC(11)"[17
" "]"                                       JM
•1050 GOTO255                               CG
•1100 POKE53281,7:POKE53280,0               CI
•1120 PRINT"[CLEAR][HOME]"SPC(13)"[RED][3
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering *Ahoy!* programs. Refer to these pages **before** entering any programs!

```
"*"][BLACK]WELCOME[RED][3"*"]"                 JK
·1140 PRINT"[DOWN]"SPC(14)"[BLUE]DUCK--SH
OOT"                                           PN
·1160 PRINTSPC(8)"[BLUE]A SHOOTING GALLER
Y GAME[DOWN]"                                  HI
·1180 PRINTSPC(5)"[BLACK]DUCKS ARE WORTH
25 PTS EACH[DOWN]"                             HE
·1200 PRINTSPC(5)"WHEN YOU SHOOT DOWN 10
DUCKS[DOWN]"                                   CC
·1210 PRINTSPC(5)"YOU ENTER A TIMED TARGE
T ROUND[DOWN]"                                 BK
·1220 PRINTSPC(5)"TARGETS ARE WORTH 50 PT
S EACH[DOWN]"                                  NC
·1230 PRINTSPC(5)"THE MORE DUCKS YOU [RED
]SHOOT[BLACK] DOWN[DOWN]"                      GJ
·1240 PRINTSPC(5)"THE [RED]FASTER[BLACK]
THEY WILL GO[DOWN]"                            MF
·1241 PRINTSPC(5)"WHEN YOU MISS 4 DUCKS I
N A ROW[DOWN]"                                 NN
·1242 PRINTSPC(5)"THE GAME IS OVER[DOWN]"      JE
·1245 PRINTSPC(5)"USE JOYSTICK--PORT #2"       GJ
·1250 PRINT"[HOME][23"[DOWN]"]"SPC(8)"[GR
EEN]PRESS ANY KEY TO BEGIN":FORL=1TO90:N
EXT                                            FI
·1255 PRINT"[HOME][23"[DOWN]"]"SPC(8)"[YE
LLOW]PRESS ANY KEY TO BEGIN":FORL=1TO10:
NEXT                                           HH
·1260 GETA$:IFA$=""THEN1250                    KE
·1270 PRINT"[CLEAR]":POKE53281,6               KA
·1300 RETURN                                   IM
·2000 DATA 0,0,0,0,0,0,0,0                     FG
·2010 DATA 0,0,0,0,0,0,0,0                     FG
·2020 DATA 0,0,0,0,0,0,40,0                    HH
·2030 DATA 0,146,0,1,17,0,1,85                 MC
·2040 DATA 0,1,17,0,0,146,0,0                  LK
·2050 DATA 40,0,0,0,0,0,0,0                    FP
·2060 DATA 0,0,0,0,0,0,0,0                     FG
·2070 DATA 0,0,0,0,0,0,0                       PD
·2080 DATA 0,0,0,0,0,0,0,0                     FG
·2090 DATA 0,0,0,0,0,0,0,0                     FG
·2100 DATA 0,160,0,1,80,0,1,31                 NJ
·2110 DATA 0,2,213,0,5,0,2,169                 AH
·2120 DATA 0,11,233,64,53,86,32,238            BH
·2130 DATA 236,32,21,64,32,5,128,64            BB
·2140 DATA 0,85,0,0,0,0,0,0                    KC
·2150 DATA 0,0,0,0,0,0,0                       PD
·2160 DATA 0,0,0,0,0,0,0,0                     FG
·2170 DATA 0,0,0,0,0,0,0,0                     FG
·2180 DATA 0,160,0,1,80,0,1,31                 NJ
·2190 DATA 0,2,240,0,5,14,2,169                DL
·2200 DATA 0,11,233,64,53,86,32,239            BG
·2210 DATA 188,32,21,64,32,5,128,64            KH
·2220 DATA 0,85,0,0,0,0,0,0                    KC
·2230 DATA 0,0,0,0,0,0,0                       PD
```

SCREEN DUMPING

FROM PAGE 73

VERSION I

```
·1 REM BEFORE LOADING THIS PROGRAM YOU MU
ST POKE44,64:POKE16384,0:NEW                   KA
·20 B=8192 :POKE53272,24                       CN
·25 POKE 53265,PEEK(53265) OR 32               AL
·30 FOR I=0 TO 7999 : POKE B+I,0 : NEXT        GC
·40 FOR J=1024 TO 2043 :POKEJ,1:NEXT           PO
·100 FOR X = 0 TO 319 STEP .4                  BO
·105 Y=INT(100-(100*COS(X/05))*EXP(-X/240
))                                             FJ
·150 CHAR=INT(X/8)                             PI
·155 ROW=INT(Y/8)                              AG
·160 LINE=Y AND 7                              BC
·165 BYTE = B + ROW*320 + CHAR*8 + LINE        AF
·170 BIT=7-(X AND 7)                           PJ
·175 POKE BYTE,PEEK (BYTE) OR (2[UPARROW]
BIT)                                           DO
·180 NEXT X                                    NK
·190 GET A$: IF A$<>CHR$(133) THEN 190         IH
·205 OPEN4,4,5:CMD4:PRINT CHR$(10) CHR$(1
0)                                             HO
·210 PRINT CHR$(27)"@":PRINT CHR$(27) CHR
$(51) CHR$(16)                                 AF
·215 PRINT"[10" "]";                           FG
·220 PRINT"[54"-"]"CHR$(10)                    JK
·225 FORL=0 TO 24:PRINT CHR$(27) CHR$(76)
 CHR$(249) CHR$(2);                            FK
·230 FOR I=1 TO 119:PRINT CHR$(0);:NEXTI:
PRINT CHR$(245);                               LD
·235 FOR CR = 0 TO 39:                         EI
·240 FOR P  = 0 TO 7:PBYT=0:E=2[UPARROW](
7-P)                                           HE
·245 FOR LC = 0 TO 7                           NM
·250 PBYT = PBYT-((PEEK(B+LC) AND E)>0)*2
[UPARROW](7-LC)                                PI
·255 NEXT LC: PRINT CHR$(PBYT) CHR$(PBYT)
;                                              AM
·260 NEXT P : B=B+8                            CN
·265 NEXT CR: PRINT CHR$(245) CHR$(10);        EP
·270 NEXT L:PRINT CHR$(27)"@"                  KP
·275 PRINT"[10" "]";                           FG
·280 PRINT"[54"-"]"                            ON
·285 PRINT#4,:CLOSE4                           AO
·290 END                                       IC
```

VERSION II

```
·1 REM BEFORE LOADING THIS PROGRAM YOU MU
ST POKE44,64:POKE16384,0:NEW                   KA
·5 S0 = PEEK(46)*256 + PEEK(45) : S1 = S0
-210 : S2 = S0-150 : B = 8192                  JL
·30 SYS S1                                     CF
·100 FOR X = 0 TO 319 STEP .4                  BO
```

All the programs in this issue of *Ahoy!* are available on disk or cassette. See page 53.

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
·105 Y=INT(100-(100*COS(X/05))*EXP(-X/240
 ))                                            FJ
·150 CHAR=INT(X/8)                             PI
·155 ROW=INT(Y/8)                              AG
·160 LINE=Y AND 7                              BC
·165 BYTE = B + ROW*320 + CHAR*8 + LINE        AF
·170 BIT=7-(X AND 7)                           PJ
·175 POKE BYTE,PEEK (BYTE) OR (2[UPARROW]
 BIT)                                          DO
·180 NEXT X                                    NK
·190 GET A$: IF A$<>CHR$(133) THEN 190         IH
·195 POKE 251,0 : POKE 252,32                  KO
·200 FOR I = 0 TO 7 : POKE 2048+I,2[UPARR
 OW]I : NEXT                                   FP
·205 OPEN4,4,5:CMD4:PRINT CHR$(10) CHR$(1
 0)                                            HO
·210 PRINT CHR$(27)"@":PRINT CHR$(27) CHR
 $(51) CHR$(16)                                AF
·215 PRINT"[10" "]";                           FG
·220 PRINT"[54"-"]"CHR$(10)                    JK
·225 FORL=0 TO 24:PRINT CHR$(27) CHR$(76)
  CHR$(250) CHR$(2);                           IA
·230 SYS S2                                    CE
·265 PRINT CHR$(245) CHR$(10);                 PC
·270 NEXT L:PRINT CHR$(27)"@"                  KP
·275 PRINT"[10" "]";                           FG
·280 PRINT"[54"-"]"                            ON
·285 PRINT#4,:CLOSE4                           AO
·290 END                                       IC
```

Machine code to be appended to VERSION II (see article for instructions)

```
169 24 141 24 208 169 32 13 17 208 141 17
208 169 32 133 252 160 0 132 251 169 0 145
251 200 208 251 166 252 232 134 252 224 64
208 242 169 4 133 252 132 251 169 1 145
251 200 208 251 166 252 232 134 252 224  8
208 242 96 162 0 169 0 32 210 255 232 224
120 208 246 169 245 32 210 255 169 0 141 8
8 141 9 8 141 10 8 141 11 8 169 7 56 237 9
8 170 189 0 8 141 12 8 169 7 56 237 10 8
170 189 0 8 141 13 8 172 10 8 177 251 45
12 8 240 10 173 13 8 24 109 11 8 141 11 8
174 10 8 232 142 10 8 224 8 208 212 173 11
8 32 210 255 32 210 255 169 0 141 10 8 141
11 8 174 9 8 232 142 9 8 224 8 208 171 169
0 141 9 8 169 8 24 101 251 133 251 144 5
166 252 232 134 252 174 8 8 232 142 8 8
224 40 208 141 96
```

SPEEDY

FROM PAGE 56

```
·2 GOTO85                                      PL
·4 P=-22:GOTO39                                GG
·5 P=+22:GOTO39                                FB
·7 P=-1:GOTO39                                 AK
·8 P=-23:GOTO39                                FB
·9 P=+21:GOTO39                                GG
·11 P=+1:GOTO39                                BF
·12 P=-21:GOTO39                               EL
·13 P=+23:GOTO39                               FE
·15 POKEE-2,241:O=O+7:POKEE,241:F=F+1:IFF
=ZTHEN52                                       ED
·16 POKEE,135:POKEE-2,0:GOTO48                 CP
·30 PRINT"[CLEAR]":V=36878:POKEV,15:POKEV
-9,255:POKEV+1,8:E=36876:A=7911:B=30720:
Z=Z+5:P=0                                      FI
·31 TT=INT(RND(1)*400)+7746:POKETT,3           EP
·32 FORT=1TOZ+EC*2:POKEE,135:TT=INT(RND(1
)*418)+7746:POKETT+B,4:POKETT,2:POKEE,0:
NEXT                                           GI
·34 FORT=1TOZ:POKEE,241:TT=INT(RND(1)*418
)+7746:IFPEEK(TT)=1THENF=F+1                   BD
·35 POKETT+B,5:POKETT,1:POKEE,0:NEXT           IJ
·36 FORT=1TO500:NEXT:POKEE,135:POKEE-1,13
5                                              OB
·38 POKEA+B,2:POKEA,.:POKEG,32:D=PEEK(828
):SYS831:ONDGOTO4,5,6,7,8,9,10,11,12,13        AJ
·39 G=A:A=A+P:PRINT"[HOME][WHITE][RVSON]S
CORE=";O;" CLONES=";S:Q=PEEK(A):IFQ=1THE
N15                                            LJ
·41 IFQ=2THEN60                                NO
·42 IFQ=3THEN56                                NG
·43 IFA>8142THENA=A-484                        GL
·44 IFA<7724THENA=A+484                        IB
·48 GOTO38                                     PB
·52 POKEG,32:POKEA,.:POKEA+B,2:POKEE-2,24
1:FORT=1TO500:NEXT:POKEE-1,241:FORT=1TO5
00:NEXT                                        OI
·53 RL=RL+1:POKEE,241:FORT=1TO900:NEXT:PO
KEE,.:POKEE-2,.:POKEE-1,.                      MP
·54 S=S+1:P=0:F=0:GOTO30                       DP
·56 POKEE,0:POKEG,32:POKEA,.:POKEA+B,2:PO
KEE,155:GOSUB59:POKEE,0:GOSUB59:POKEE,20
0                                              MI
·57 GOSUB59:POKEE,0:GOSUB59:POKEE,241:GOS
UB59:POKEE,0:GOSUB59:POKEE,135:O=O+F*EC:
P=0                                            DH
·58 GOTO43                                     PB
·59 FORT=1TO100:NEXT:RETURN                    HC
·60 POKEG,32:POKEA,4:POKEA+B,7:FORT=15TO0
STEP-1:POKEV,T:POKEE+1,225+T:NEXT:POKEE+
1,0                                            PA
·62 S=S-1:IFS=0THEN65                          CE
·63 P=0:F=0:Z=Z-5:GOTO30                       BG
·65 O=O+RL*50:PRINT"[HOME][11"[DOWN]"] [5
"[RIGHT]"][RVSON][YELLOW]GAME OVER[BLACK
]":FORT=1TO1000:NEXT:IFO>LTHENL=O              IG
·66 POKE36879,24:PRINT"[CLEAR][DOWN][RVSO
N]YOUR[DOWN][4"[LEFT]"]SCORE=";O:PRINT"[
3"[DOWN]"][RVSON]HIGH[DOWN][4"[LEFT]"]SC
```

```
ORE=";L                                        FJ
·67 IFO<LANDL-O<50THENPRINT"[DOWN][DOWN][
RVSON]CLOSE,BUT NOT CLOSE[6" "]ENOUGH."        BM
·68 PRINT"[DOWN][DOWN][RVSON]YOU GOT TO S
CREEN";RL:PRINTRL*50;"[RVSON]BONUS.":PRI
NT"[3"[DOWN]"][RVSON]HIT A KEY TO TRY AG
AIN"                                           NP
·69 GETA$:IFA$=""THEN69                        GE
·70 P=0:O=0:F=0:Z=0:GOTO99                     JJ
·72 POKE36879,8:PRINT"[CLEAR][3"[DOWN]"][
8"[RIGHT]"][RVSON][YELLOW]S[RED]P[GREEN]
E[CYAN]E[PURPLE]D[YELLOW]Y":PRINT"[DOWN]
[PURPLE][8"[RIGHT]"]BY[DOWN][LEFT][LEFT]
KEVIN[DOWN][5"[LEFT]"]DEWEY"                   MJ
·73 POKE36869,240:PRINT"[DOWN][GREEN]SKIL
L LEVEL(1-15)";:INPUTEC                        FF
·74 IFEC<1OREC>15THEN72                        EE
·75 GOTO30                                     OJ
·85 POKE52,28:POKE56,28:CLR:FOR A=828 TO
881:READB:POKEA,B:NEXT                         AC
·86 FORI=7168TO7679:POKEI,PEEK(I+25600):N
EXT:FORC=7168TO7208:READB:POKEC,B:NEXT         MH
·90 DATA 0,0,0,169,127,141,34,145,169,0,1
41,19,145,173,32,145,74,74,41,32,141,62,
3                                              EL
·91 DATA 173,17,145,41,28,13,62,3,74, 74,
73,15,141,60,3,173,17,145,41,32                MD
·92 DATA 73,32,141,61,3,169,255,141,34,14
5,96                                           PJ
·93 DATA60,126,219,255,231,189,66,60,255,
126,90,255,165,189,129,255,255,90,126,23
1,255                                          IH
·94 DATA129,189,255,255,145,145,159,249,1
37,137,255,137,74,44,224,7,52,82,145,0,0       JN
·99 S=7:RL=1:GOTO72                            BI
```

MAPPING 4.4

FROM PAGE 45

```
·1 REM ********************************        DN
·2 REM *         MAPPING 4.4          *        HN
·3 REM *              BY              *        IA
·4 REM *         J.M.MARCANO          *        PB
·5 REM ********************************        DN
·6 REM            8/29/84                      AN
·10 REM ****** CENTRAL SECTION ******          II
·15 POKE53280,8:POKE53281,0:D$="? ? ?"         NF
·20 PRINTCHR$(147):FORI=1TO11:PRINT:NEXT:
PRINTCHR$(158)SPC(17)"WAIT"                    GA
·25 FOR AD=828TO888:READVA:POKEAD,VA:NEXT
AD                                             GM
·30 FORI=49152TO49543:READC:POKEI,C:NEXT       HE
·40 SYS49309:SYS49385:POKE81,197:SYS49512
:GOSUB160:SYS49152:GOSUB100:GOSUB350           EA
·50 REM ** ALL THE FUNCTIONS COME HERE **      LL
·55 DEFFNF(X)=SIN(X)                           EN
·60 GOSUB210                                   CD
·70 ONKGOTO260,790,490,280,810,830,850,60      LL
·100 REM *** DIRECTORY FOR F'S KEYS ****       FK
·110 PRINTCHR$(19)CHR$(30):FORI=1TO20:PRI
NT:NEXT                                        OP
·115 PRINT" F1:GRAPHIC CLEANER[7" "]F2:ST
ORE(M+)"                                       DB
·120 PRINT" F3:RANGE CHANGER[9" "]F4:RECA
LL"                                            LD
·130 PRINT" F5:FUNCTION CHANGER[6" "]F6:C
LEAR MRY"                                      NK
·140 PRINT" F7:COMPARE WITH MRY[6" "]F8:N
O DEFINED"CHR$(19)CHR$(154)                    HL
·150 RETURN                                    IM
·160 REM **TRANSFER THE CHAR. TO SCREEN**      BI
·170 C=55341:J=1069:L=106                      FH
·180 FORI=0TO14:POKEJ+I,L:POKEC+I,1:L=L+1
:NEXT                                          BA
·190 C=C+40:J=J+40:IFJ<1464THEN180             ML
·200 RETURN                                    IM
·205 REM *** SET UP ERROR TRAPPING IN 870
***                                            CL
·206 T$="GOTO"+STR$(870)+CHR$(0)               MJ
·207 FOR AD=1 TO LEN(T$):POKE891+AD,ASC(M
ID$(T$,AD,1)):NEXTAD                           PG
·208 SYS875                                    EF
·209 RETURN                                    IM
·210 REM ****** INPUT SUBROUTINE ******         BK
·215 GOSUB205                                  CJ
·220 GETK$:IFK$=""THEN220                      GH
·230 IFK$=CHR$(133)ORK$=CHR$(134)ORK$=CHR
$(135)ORK$=CHR$(136)THEN240                    PH
·231 IFK$=CHR$(137)ORK$=CHR$(138)ORK$=CHR
$(139)ORK$=CHR$(140)THEN240                    IG
·235 GOTO220                                   BM
·240 K=ASC(K$)-132                             NL
·250 RETURN                                    IM
·260 REM **CLEAR CHAR.** (F1 ROUTINE)          MI
·270 SYS49385:GOTO60                           MA
·280 REM **CLEAR OPERATION** (F7 ROUTINE)      ON
·285 ONNGOTO290,295                            NP
·290 POKE81,202:SYS49512:POKE81,202:SYS49
416:POKE81,197:SYS49464:N=2:GOTO60             JB
·295 SYS49385:POKE81,202:SYS49464:N=1:GOT
O60                                            HM
·300 REM *** CLEAR DATA AREA ***               CG
·310 FORJ=1064TO1424STEP40                     NL
·320 FORI=J+23TOJ+39:POKEI,32:NEXTI:NEXTJ
:RETURN                                        KF
·330 REM *** CLEAR WORK AREA ***               GD
·340 FORI=1544TO1743:POKEI,32:NEXT:RETURN      CI
·350 REM *** SET UP DATA AREA ***              FM
·360 PRINTCHR$(19)CHR$(159):PRINT:PRINTTA
B(23)"X0=";X0                                  GM
·370 PRINTTAB(23)"XM=";XM                      NO
·380 PRINTTAB(23)"Y0=";Y0                      LI
·390 PRINTTAB(23)"YM=";YM                      OK
·400 PRINT:PRINTTAB(23)"PIXELS:";DX            BA
·410 PRINT:PRINTTAB(23)"DATA FROM "CHR$(1
54);D$                                         FD
```

```
·420 RETURN                                    IM
·430 REM *** SET UP THE FUNCTION AREA ***      CN
·440 FORI=0TO39:POKE1784+I,32:NEXT             JM
·450 PRINTCHR$(19)CHR$(159):FORI=1TO18:PR
INT:NEXT:PRINT" Y=";A$                         KH
·460 RETURN                                    IM
·470 REM **** POSITION ON WORK AREA ****       BA
·480 PRINTCHR$(19):FORI=1TO13:PRINT:NEXT:
RETURN                                         FI
·490 REM **INPUT FUNCTION **(F5 ROUTINE)       OD
·495 GOSUB330:GOSUB470                         IH
·500 PRINTCHR$(159)"ENTER THE 2DN MEMBER
OF THE F'N ON X "                              GE
·505 INPUTA$:IFLEN(A$)<29THEN510               IH
·506 PRINT"MUST HAS LESS THAN 29 CHARACTE
RS":FORI=0TO1000:NEXT:GOTO495                  FH
·510 GOSUB330:GOSUB430:PRINTCHR$(19)CHR$(
144):FORI=1TO14:PRINT:NEXT:PRINT;              NE
·520 PRINT"55D[s E]FNF(X)=";A$                 MA
·530 PRINT"RUN50                               BO
·550 POKE631,13:POKE632,13:POKE633,13:POK
E198,3:END                                     IL
·560 REM ***INPUT RANGE SUBROUTINE***          CP
·570 PRINTCHR$(154):GOSUB330:GOSUB470:INP
UT"X0,XM";X0,XM                                OJ
·580 IFX0<XMTHEN600                            LA
·590 PRINT"MUST BE X0<XM":FORI=0TO1000:NE
XT:GOTO570                                     AH
·600 GOSUB330:GOSUB470:INPUT"Y0,YM";Y0,YM      KE
·610 IFY0<YMTHEN630                            LH
·620 PRINT"MUST BE Y0<YM":FORI=0TO1000:NE
XT:GOTO600                                     AF
·630 GOSUB330:GOSUB470:INPUT"AMOUNT OF PI
XELS FOR THE GRAPHIC";DX                       AK
·635 IFDX>0THENGOSUB330:RETURN                 KL
·640 PRINT"MUST BE >0":FORI=0TO1000:NEXT:
GOTO630                                        NH
·650 REM **** FUNCTION EVALUATER ****          ME
·660 IFSGN(X0)=SGN(XM)THEN670                  NP
·665 X=-X0*119/(XM-X0):FORY=0TO79STEP5:GO
SUB750:NEXT                                    ID
·670 IFSGN(Y0)=SGN(YM)THEN700                  AB
·675 Y=Y0*79/(YM-Y0)+79:FORX=0TO119STEP5:
GOSUB750:NEXT                                  KG
·700 SX=(XM-X0)/DX                             ND
·710 FORI=X0TOXMSTEPSX                         ME
·720 F=FNF(I):IFF<Y0ORF>YMTHEN740              CH
·730 X=(I-X0)/(XM-X0)*119:Y=(Y0-F)/(YM-Y0
)*79+79:GOSUB750                               LA
·740 NEXT:RETURN                               EJ
·750 REM ****** GRAPHIC MAKER ******           FJ
·760 RO=INT(Y/8):CH=INT(X/8):LI=YAND7          BN
·770 BIT=7-(XAND7):BYT=13136+RO*120+CH*8+
LI:POKEBYT,PEEK(BYT)OR(2[UPARROW]BIT)          LC
·780 RETURN                                    IM
·790 REM **INPUT RANGE ROUTINE**(F3-ROUTI
NE)                                            PI
·800 D$="USER":GOSUB560:GOSUB300:GOSUB650
:GOSUB350:GOTO60                               BN
·810 REM **** STORE (F2-ROUTINE) ****          KA
·815 POKE81,197                                MC
·820 SYS49416:X1=X0:X2=XM:Y1=Y0:Y2=YM:DM=
DX:POKE55296,5:POKE1024,13:GOTO60              MF
·830 REM **** RECALL **** (F4-ROUTINE)         LH
·840 POKE81,197:SYS49464:IFX1=X2THENGOTO6
0                                              NA
·842 D$="MEMORY":GOSUB300:X0=X1:XM=X2:Y0=
Y1:YM=Y2:DX=DM:GOSUB350:GOTO60                 IB
·850 REM **MEMORY CLEANER** (F6-ROUTINE)       MN
·860 POKE81,197:SYS49512:POKE55296,0:GOTO
60                                             DM
·870 REM *** ERROR TRAPPING ***                IL
·880 GOSUB470                                  CP
·885 EN=PEEK(889):IFEN>127THENPRINTCHR$(1
9):FORI=1TO11:PRINT:NEXT:END                   MG
·900 IFEN=11THENPRINT"CHECK THE FUNCTION.
 USE <F5>"                                     KP
·910 IFEN=20THENPRINT"DIVISION BY ZERO.[4
" "]CHANGE RANGE"                              BE
·920 IFEN=25THENPRINT"THE FUNCTION IS TOO
 COMPLEX. REDEFINE IT"                         KC
·930 IFEN=15THENPRINT"NUMBER TOO SMALL OR
 TOO HIGH.REDIFINE IT"                         BF
·940 IFEN=5THENPRINT"DEVICE NOT PRESENT.
REPEAT OPERATION"                              DN
·950 GOTO50                                    PD
·5000 REM ** MACHINE LANGUAGE ROUTINES **      JA
·5010 REM 49152-SET UP THE FORMAT              GM
·5020 REM 49309-MOVE CHARACTERS RAM[BACKA
RROW]ROM                                       NP
·5030 REM 49385-CLEAR THESE CHARACTERS         DI
·5040 REM 49416-STORE ROUTINE                  HH
·5050 REM 49464-RECALL ROUTINE                 LC
·5060 REM 49512-CLEAR ROUTINE                  NE
·5070 REM 00875-SET UP TRAPPING                FI
·5950 DATA169,139,141,0,3,169,227,141,1,3
,165,58,141,123                                JE
·5960 DATA3,201,255,240,39,165,57,141,122
,3,142,121,3,160                               CP
·5970 DATA0,185,124,3,153,0,2,240,3,200,2
08,245,162,255                                 OP
·5980 DATA160,1,76,134,164,169,60,141,0,3
,169,3,141,1                                   NH
·5990 DATA3,96,108,0,3                         MJ
·6000 DATA169,61,162,40,157,223,5,157,207
,6,202,208,247,169,4,162,40,157,223,217        DN
·6010 DATA157,207,218,157,31,219,202,208,
244,169,45,162,40,157,31,7,202,208,250         PI
·6020 DATA169,72,162,0,157,44,4,157,84,4,
157,124,4,157,164,4,157,204,4,157,244          LH
·6030 DATA4,157,28,5,157,68,5,157,108,5,1
57,148,5,208,5,162,16,169,71,76,43,192         PA
·6040 DATA169,13,162,0,157,44,216,157,84,
216,157,124,216,157,164,216,157,204,216        CD
·6050 DATA157,244,216,157,28,217,157,68,2
17,157,108,217,157,148,217,208,5,162,16        KH
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering *Ahoy!* programs. Refer to these pages **before** entering any programs!

```
•6060 DATA76,86,192,169,69,162,15,157,188
,5,202,208,250,169,82,162,15,157,4,4      HB
•6070 DATA202,208,250,169,13,162,15,157,1
88,217,157,4,216,202,208,247,96,173,14    AH
•6080 DATA220,41,254,141,14,220,165,1,41,
251,133,1,169,0,133,80,133,78,169,208     DH
•6090 DATA133,81,169,48,133,79,162,8,160,
0,177,80,145,78,136,192,0,208,247,202     LB
•6100 DATA240,7,230,81,230,79,76,189,192,
165,1,9,4,133,1,173,14,220,9,1,141,14     BD
•6110 DATA220,173,24,208,41,240,9,12,141,
24,208,96                                 MK
•6120 DATA169,80,133,80,169,0,160,0,162,5
1,134,81,145,80,136,208,251,232,224,55    NE
•6130 DATA208,244,153,80,55,200,192,177,2
08,248,96                                 FA
•6140 DATA169,80,133,78,169,51,133,79,169
,0,133,80,234,234,234,234,162,5,160,0     FM
•6150 DATA177,78,17,80,145,80,200,208,247
,230,81,230,79,202,208,240,177,78,17      GC
•6160 DATA80,145,80,200,192,177,208,245,9
6,169,80,133,78,169,51,133,79,169,0       AG
•6170 DATA133,80,234,234,234,234,162,5,16
0,0,177,80,17,78,145,78,200,208,247       AI
•6180 DATA230,81,230,79,202,208,240,177,8
0,17,78,145,78,200,192,177,208,245,96     DE
•6190 DATA169,0,133,80,234,234,234,234,16
2,5,160,0,169,0,145,80,200,208,251        JD
•6200 DATA230,81,202,208,246,145,80,200,1
92,177,208,249,96                         NK
```

TOWERS OF HANOI

FROM PAGE 17

```
•10 REM - TOWERS OF HANOI FOR COMMODORE 6
4                                         OE
•20 REM - DANIEL MILLER                   DK
•30 REM - 2815 34 STREET                  OA
•40 REM - ASTORIA, QUEENS                 AL
•50 REM - NEW YORK, NEW YORK   11103      GM
•60 REM - SEPTEMBER 1, 1983               HN
•70 REM ********************************  DD
•80 GOTO2150                              FL
•90 POKE53281,1:ZZ=1:PRINTCL$;LEFT$(DO$,2
);TAB(11);HDG$;                           NF
•100 POKE55587,10:POKE1315,49:POKE55595,1
0:POKE1323,50:POKE55603,10:POKE1331,51    DF
•110 PRINT LEFT$(DO$,20);TAB(5);A$(1);LEF
T$(DO$,9);TAB(11);A$(3);                  EB
•120 PRINTLEFT$(DO$,9);TAB(19);A$(3);LEFT
$(DO$,9);TAB(27);A$(3)                    HK
•130 REM - PLACE SPRITES ON TOWER #1      PM
•140 POKEV+14,93:POKEV+15,160:POKEV+12,93
:POKEV+13,151:POKEV+10,93:POKEV+11,142    ML
•150 POKEV+8,93:POKEV+9,133:POKEV+6,93:PO
KEV+7,124:POKEV+4,93:POKEV+5,115          II
•160 POKEV+2,93:POKEV+3,106:POKEV+0,93:PO
KEV+1,97                                  OA
•170 IF YN$="Y" THENN2=8-NUM:GOTO200      FO
•180 IF ZZ=0 THEN350                      HO
•190 PRINTLEFT$(DO$,22);TAB(8);NUM$;:INPU
T NUM:N2=8-NUM:SP=0:IF NUM=8 THEN270      KC
•200 IF NUM<2 OR NUM>8 THENPRINT LEFT$(DO
$,22);TAB(5);SP$;:GOTO190                 MH
•210 IF NUM=8 AND YN$="Y" THEN270         HA
•220 N4=N2                                LG
•230 FOR X=1 TO N4                        NB
•240 SP=SP+(2[UPARROW](N4-1))             HP
•250 N4=N4-1:NEXT X                       KC
•260 POKEV+21,(255-SP)                    GP
•270 ZZ=0:FOR TM=1 TO 250:NEXT TM:PRINTLE
FT$(DO$,22);TAB(5);SP$;                   LF
•280 T1$="":T2$="":T3$="":N3=N2+1         DB
•290 FOR X=1 TO NUM:T1$=T1$+T4$(X):T2$=T2
$+T5$(X):T3$=T3$+T6$(X):NEXT X            GN
•300 IF YN$="Y" THEN1430                  BE
•310 FOR X=1 TO NUM:Y=2[UPARROW]X-1:NEXT
X                                         NG
•320 NUM$=RV$+G2$+STR$(NUM)+RO$+SLV$(1)+R
V$+G2$+STR$(Y)+SLV$(2):Y0=Y               NL
•330 PRINTLEFT$(DO$,22);TAB(6);NUM$;:FOR
TM=1 TO 2000:NEXT TM                      LF
•340 FOR TM=1 TO 250:NEXT TM:PRINTLEFT$(D
O$,22);TAB(5);SP$;                        PF
•350 PRINTLEFT$(DO$,22);TAB(6);F9$;"[4" "
]";TAB(24);T9$;"[4" "]";                  KA
•360 PRINTLEFT$(DO$,22);TAB(6);F9$;" ";CR
$;                                        GG
•370 NUM$="":SLV$(1)="":SLV$(2)=""        OD
•380 IF ZA=2 THEN420                      FP
•390 GET TWR$(1):IF TWR$(1)="" THEN390    AO
•400 IF TWR$(1)="[F1]" THEN1330:REM - 'F1
'                                         MN
•410 IF (TWR$(1)<"1" OR TWR$(1)>"3") THEN
TWR$(1)="":GOTO390                        FB
•420 PRINT RV$+RED$+TWR$(1)+RO$;          BN
•430 GOSUB520                             CL
•440 PRINTLEFT$(DO$,22);TAB(34);" ";CR$;  DN
•450 IF ZA=2 THEN480                      FB
•460 GET TWR$(2):IF TWR$(2)="" THEN460    GI
•470 IF TWR$(2)<"1" OR TWR$(2)>"3" THENTW
R$(2)="":GOTO460                          BK
•480 PRINT RV$+RED$+TWR$(2)+RO$;          FC
•490 IF TWR$(1)<>TWR$(2) THEN510          AJ
•500 ER$=RV$+RED$+" INVALID ENTRIES"+RO$:
GOTO610                                   BL
•510 GOTO640                              CG
•520 X=1:GOSUB530:RETURN                  GM
•530 ON VAL(TWR$(X)) GOTO540,560,580      GI
•540 IF VAL(T1$)=0 THEN600                HL
•550 RETURN                               IM
•560 IF VAL(T2$)=0 THEN600                FG
```

```
•570 RETURN                                        IM
•580 IF VAL(T3$)=0 THEN600                         HJ
•590 RETURN                                        IM
•600 ER$=RV$+RED$+"TOWER # "+TWR$(X)+" IS
 EMPTY"+RO$                                        HB
•610 FOR Y=1 TO 5:PRINTLEFT$(DO$,24);TAB(
12)ER$;:FOR TM=1 TO 250:NEXT TM                    PJ
•620 PRINTLEFT$(DO$,24);TAB(12);LEFT$(SP$
,18);:FOR TM=1 TO 250                              ND
•630 NEXT TM,Y:ER$="":GOTO350                      NE
•640 ON VAL(TWR$(1)) GOTO650,680,710               DN
•650 FOR X=1 TO NUM:IF MID$(T1$,X,1)="1"
THEN670                                            GA
•660 NEXT X:LOC(1)=160:GOTO740                     GN
•670 LOC(1)=T1(N2+X):T4$(N2+X)="0":GOTO74
0                                                  LF
•680 FOR X=1 TO NUM:IF MID$(T2$,X,1)="1"
THEN700                                            BP
•690 NEXT X:LOC(1)=160:GOTO740                     GN
•700 LOC(1)=T2(N2+X):T5$(N2+X)="0":GOTO74
0                                                  DB
•710 FOR X=1 TO NUM:IF MID$(T3$,X,1)="1"
THEN730                                            DD
•720 NEXT X:LOC(1)=160:GOTO740                     GN
•730 LOC(1)=T3(N2+X):T6$(N2+X)="0"                 KB
•740 LC=LOC(1):GOSUB880:SP(1)=SP                   NF
•750 ON VAL(TWR$(2)) GOTO760,790,820               OK
•760 FOR X=1 TO NUM:IF MID$(T1$,X,1)="1"
THEN780                                            GG
•770 NEXT X:LOC(2)=160:T4$(N2+X-1)="1":GO
TO850                                              IG
•780 LOC(2)=T1(N2+X-1):T4$(N2+X-1)="1":GO
TO850                                              EP
•790 FOR X=1 TO NUM:IF MID$(T2$,X,1)="1"
THEN810                                            GJ
•800 NEXT X:LOC(2)=160:T5$(N2+X-1)="1":GO
TO850                                              MD
•810 LOC(2)=T2(N2+X-1):T5$(N2+X-1)="1":GO
TO850                                              LN
•820 FOR X=1 TO NUM:IF MID$(T3$,X,1)="1"
THEN840                                            DJ
•830 NEXT X:LOC(2)=160:T6$(N2+X-1)="1":GO
TO850                                              LA
•840 LOC(2)=T3(N2+X-1):T6$(N2+X-1)="1"             AF
•850 LC=LOC(2):GOSUB880:SP(2)=SP                   DJ
•860 T1$="":T2$="":T3$="":N5=N2+1                  OH
•870 FOR X=N5 TO 8:T1$=T1$+T4$(X):T2$=T2$
+T5$(X):T3$=T3$+T6$(X):NEXT X:GOTO960              EF
•880 IF LC=97 THENSP=1:RETURN                      EN
•890 IF LC=106 THENSP=2:RETURN                     GL
•900 IF LC=115 THENSP=3:RETURN                     FA
•910 IF LC=124 THENSP=4:RETURN                     HB
•920 IF LC=133 THENSP=5:RETURN                     GO
•930 IF LC=142 THENSP=6:RETURN                     HH
•940 IF LC=151 THENSP=7:RETURN                     HM
•950 IF LC=160 THENSP=8:RETURN                     GN
•960 ON VAL(TWR$(1)) GOTO970,980,990               BP
•970 SQ%=R1%(1,SP(1)):R1%(1,SP(1))=8:GOTO
1000                                               FH
•980 SQ%=R2%(1,SP(1)):R2%(1,SP(1))=8:GOTO
1000                                               KN
•990 SQ%=R3%(1,SP(1)):R3%(1,SP(1))=8               GI
•1000 ON VAL(TWR$(2)) GOTO1010,1020,1030           HF
•1010 R1%(1,SP(2))=SQ%:GOTO1040                    IH
•1020 R2%(1,SP(2))=SQ%:GOTO1040                    KK
•1030 R3%(1,SP(2))=SQ%                             EE
•1040 ON VAL(TWR$(1)) GOTO1050,1060,1070           NM
•1050 X1=93:GOTO1080                               DC
•1060 X1=157:GOTO1080                              HJ
•1070 X1=222                                       NL
•1080 ON VAL(TWR$(2)) GOTO1090,1100,1110           JF
•1090 X2=93:GOTO1120                               EA
•1100 X2=157:GOTO1120                              IB
•1110 X2=222                                       NO
•1120 REM - MOVE SPRITE                            OB
•1130 ON SQ%+1 GOTO1140,1150,1160,1170,11
80,1190,1200,1210                                  OC
•1140 SP=0:SQ=1:GOTO1220                           KL
•1150 SP=2:SQ=3:GOTO1220                           MP
•1160 SP=4:SQ=5:GOTO1220                           BD
•1170 SP=6:SQ=7:GOTO1220                           OH
•1180 SP=8:SQ=9:GOTO1220                           ML
•1190 SP=10:SQ=11:GOTO1220                         CK
•1200 SP=12:SQ=13:GOTO1220                         CK
•1210 SP=14:SQ=15                                  JN
•1220 IF VAL(TWR$(1))>VAL(TWR$(2)) THEN12
60                                                 PE
•1230 FOR YY=LOC(1) TO 55 STEP-1:POKE V+S
P,X1:POKE V+SQ,YY:NEXT YY                          EA
•1240 FOR XX=X1 TO X2:POKE V+SP,XX:POKE V
+SQ,55:NEXT XX                                     BA
•1250 FOR YY=55 TO LOC(2):POKE V+SP,X2:PO
KE V+SQ,YY:NEXT YY:GOTO1290                        GE
•1260 FOR YY=LOC(1) TO 55 STEP-1:POKE V+S
P,X1:POKE V+SQ,YY:NEXT YY                          EA
•1270 FOR XX=X1 TO X2 STEP-1:POKE V+SP,XX
:POKE V+SQ,55:NEXT XX                              MO
•1280 FOR YY=55 TO LOC(2):POKEV+SP,X2:POK
EV+SQ,YY:NEXT YY                                   NM
•1290 MV=MV+1:PRINTLEFT$(DO$,24);TAB(17);
MV$+RV$+B2$+STR$(MV)+RO$;                          HD
•1300 IF ZA=2 THENMW=MW+1:GOTO1440:REM -
COMPUTER'S NEXT MOVE                               JG
•1310 GOTO350:REM - PLAYER'S NEXT MOVE             GN
•1320 REM - COMPUTER SOLUTION                      NO
•1330 TWR$(1)="":PRINTLEFT$(DO$,24);TAB(7
);CMP$;                                            HJ
•1340 GET YN$:IF YN$="" THEN1340                   ID
•1350 IF YN$="Y" THEN1370                          BH
•1360 IF YN$<>"N" THENYN$="":GOTO1330              JG
•1370 PRINT RV$+BL$+" "+YN$+RO$;:FOR TM=1
 TO 500:NEXT TM:IF YN$="Y" THEN1420                JF
•1380 FOR TM=1 TO 1000:NEXT TM                     MJ
•1390 PRINTLEFT$(DO$,24);TAB(7);SP$;LEFT$
(DO$,24);TAB(9);EN$;                               OD
•1400 GET RT$:IF RT$<>CHR$(13) THEN1400            BI
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·1410 POKE V+21,0:PRINT CL$;:END                MG
·1420 SP=0:MV=0:MW=1:GOTO1990                   IE
·1430 YN$="":ZA=2:PRINTLEFT$(DO$,24);TAB(
 7);SP$;                                        HD
·1440 BI$="":FOR X=1 TO 8:BI$(X)="0":NEXT
 X                                              GO
·1450 IF MV=Y0 THEN1380                         PL
·1460 CT=FRE(0)                                 IL
·1470 C2=0:C3=0:C4=0:C5=0:C6=0:ZA=2             BI
·1480 DEC=MW                                    CI
·1490 FOR Y=0 TO 8:IF INT(2[UPARROW]Y)>DE
 C THENY=Y-1:BI$(Y)="1":GOTO1510                EE
·1500 BI$(Y)="0":NEXT Y                         KC
·1510 DEC=DEC-2[UPARROW]Y:IF DEC=0 THEN15
 30                                             NE
·1520 GOTO1490                                  GF
·1530 FOR Y=7 TO 0 STEP-1:BI$=BI$+BI$(Y):
 NEXT Y                                         KN
·1540 FOR X=8 TO 1 STEP-1:IF MID$(BI$,X,1
 )="0" THENC2=C2+1:NEXT X                       PG
·1550 C2=C2+1                                   IM
·1560 RI%=C2+NUM-1:ON NUM-1 GOTO1570,1580
 ,1590,1600,1610,1620,1630                      MP
·1570 RI%=RI%+4:GOTO1640                        KD
·1580 RI%=RI%+2:GOTO1640                        MB
·1590 GOTO1640                                  FM
·1600 RI%=RI%-2:GOTO1640                        MC
·1610 RI%=RI%-4:GOTO1640                        KM
·1620 RI%=RI%-6:GOTO1640                        LG
·1630 RI%=ABS(RI%-8)                            DD
·1640 FOR X=1 TO 8:IF R1%(1,X)=RI% THENTW
 R$(1)="1":GOTO1670                             HH
·1650 NEXT X:FOR X=1 TO 8:IF R2%(1,X)=RI%
  THENTWR$(1)="2":GOTO1670                      GJ
·1660 NEXT X:TWR$(1)="3"                        AO
·1670 L$=TWR$(1)                                MH
·1680 FOR X=1 TO 8:IF MID$(BI$,X,1)="1" T
 HENC3=C3+1:NEXT X:GOTO1700                     NP
·1690 NEXT X                                    NK
·1700 IF C3>1 THEN1740                          FC
·1710 IF VAL(T1$)=0 THENTWR$(2)="1":GOTO3
 50                                             FB
·1720 IF VAL(T2$)=0 THENTWR$(2)="2":GOTO3
 50                                             OH
·1730 IF VAL(T3$)=0 THENTWR$(2)="3":GOTO3
 50                                             CF
·1740 FOR X=8 TO 1 STEP-1:C4=C4+1:IF MID$
 (BI$,X,1)="0" THENNEXT X                       KG
·1750 C6=C4                                     KE
·1760 FOR X=8-C4 TO 1 STEP-1:C6=C6+1:IF M
 ID$(BI$,X,1)="0"THENC5=C5+1:NEXT X             IF
·1770 RJ%=C6+NUM-1:ON NUM-1 GOTO1780,1790
 ,1800,1810,1820,1830,1840                      KM
·1780 RJ%=RJ%+4:GOTO1850                        PC
·1790 RJ%=RJ%+2:GOTO1850                        NI
·1800 GOTO1850                                  GF
·1810 RJ%=RJ%-2:GOTO1850                        NF
·1820 RJ%=RJ%-4:GOTO1850                        KH
·1830 RJ%=RJ%-6:GOTO1850                        NJ
·1840 RJ%=ABS(RJ%-8)                            EH
·1850 FOR X=1 TO 8:IF R1%(1,X)=RJ% THENTX
 $="1":GOTO1880                                 PC
·1860 NEXT X:FOR X=1 TO 8:IF R2%(1,X)=RJ%
  THENTX$="2":GOTO1880                          KI
·1870 NEXT X:TX$="3"                            CB
·1880 M$=TX$                                    PH
·1890 LM$=L$+M$                                 AO
·1900 IF (C5/2)=INT(C5/2) OR C5=0 THENTWR
 $(2)=TX$:GOTO1970                              OF
·1910 IF LM$="12" THENTWR$(2)="3":GOTO197
 0                                              OC
·1920 IF LM$="13" THENTWR$(2)="2":GOTO197
 0                                              DC
·1930 IF LM$="23" THENTWR$(2)="1":GOTO197
 0                                              HA
·1940 IF LM$="21" THENTWR$(2)="3":GOTO197
 0                                              NI
·1950 IF LM$="31" THENTWR$(2)="2":GOTO197
 0                                              OG
·1960 IF LM$="32" THENTWR$(2)="1"               EL
·1970 L$="":M$="":LM$="":CT=FRE(0):GOTO35
 0                                              FO
·1980 REM - BUILD SPRITES                       FI
·1990 V=53248:POKEV+21,255:POKEV+23,255:P
 OKEV+29,255                                    PE
·2000 POKE2040,192:POKE2041,193:POKE2042,
 194:POKE2043,195:POKE2044,196                  ND
·2010 POKE2045,197:POKE2046,198:POKE2047,
 199                                            KP
·2020 POKEV+39,3:POKEV+40,15:POKEV+41,13:
 POKEV+42,9:POKEV+43,14:POKEV+44,5              JC
·2030 POKE V+45,8:POKEV+46,0                    CG
·2040 RESTORE:N0=12288:FOR X=1 TO 8:FOR N
 =0 TO 62:READ Q:POKE N0+N,Q:NEXT N             EF
·2050 N0=N0+64:NEXT X                           NB
·2060 T1$="[8"1"]":T2$="[8"0"]":T3$="[8"0
 "]"                                            DP
·2070 FOR X=1 TO 8:T4$(X)=MID$(T1$,X,1):N
 EXT X                                          FJ
·2080 FOR X=1 TO 8:T5$(X)=MID$(T2$,X,1):N
 EXT X                                          MJ
·2090 FOR X=1 TO 8:T6$(X)=MID$(T3$,X,1):N
 EXT X                                          PF
·2100 Z%=97:FOR X=1 TO 8:T1(X)=Z%:T2(X)=Z
 %:T3(X)=Z%:Z%=Z%+9:NEXT X                      PC
·2110 Y%=0:FOR X=1 TO 8:R1%(1,X)=Y%:Y%=Y%
 +1:NEXT X                                      PF
·2120 FOR X=1 TO 8:R2%(1,X)=9:R3%(1,X)=9:
 NEXT X                                         DM
·2130 IF YN$="Y" THEN140                        OG
·2140 GOTO90                                    PP
·2150 REM - BUILD CHARACTER GRAPHICS            PH
·2160 BLK$=CHR$(144):RED$=CHR$(28):YEL$=C
 HR$(158):B2LU$=CHR$(31):CY$=CHR$(159)          ML
·2170 G1REY$="[c 4]":G2REY$="[c 5]":REM -
  C=(4); C=(5)                                  KJ
```

```
•2180 RV$=CHR$(18):RO$=CHR$(146)                HK
•2190 CL$=CHR$(147):DW$=CHR$(17):LF$=CHR$
(157)                                           DA
•2200 FOR X=1 TO 24:DO$=DO$+DW$:NEXT X:DO
$=CHR$(19)+DO$                                  GG
•2210 A$(1)=RV$+B2$+"[30" "]"+RO$               AO
•2220 A$(2)=RV$+YEL$+" "+DW$+LF$                OK
•2230 FOR X=1 TO 10:A$(3)=A$(3)+A$(2):NEX
T X                                             NM
•2240 A$(3)=A$(3)+" "+RO$                       DB
•2250 HDG$=RV$+WH$+"TOWERS OF HANOI"+RO$        GD
•2260 NUM$=RV$+B2$+"NUMBER OF RINGS (2 -
8)"+RO$                                         NJ
•2270 SP$="[30" "]"                             PK
•2280 F9$=RV$+G1$+"FROM TOWER #"+RO$:T9$=
RV$+G1$+"TO TOWER #"+RO$                        HG
•2290 CR$=RV$+CY$+" "+RO$                       HK
•2300 SLV$(1)=RV$+G2$+" RINGS REQUIRES"+R
O$:SLV$(2)=RV$+G2$+" MOVES."+RO$                DA
•2310 MV$=RV$+B2$+"MOVE #"+RO$                  FC
•2320 CMP$=RV$+G1$+"COMPUTER SOLUTION (Y/
N) ?"+RO$                                       AP
•2330 EN$=RV$+G1$+"PRESS <RETURN> TO END"
+RO$                                            KL
•2340 GOTO1990                                  GC
•2350 REM - DATA FOR SPRITES                    NK
•2360 REM - SPRITE 0                            NB
•2370 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,:REM 53 COMMAS          LJ
•2380 DATA 1,255,128,1,255,128,1,255,128        FH
•2390 REM - SPRITE 1                            NA
•2400 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2410 DATA 3,255,192,3,255,192,3,255,192        MO
•2420 REM - SPRITE 2                            NH
•2430 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2440 DATA 7,255,224,7,255,224,7,255,224        OO
•2450 REM - SPRITE 3                            NG
•2460 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2470 DATA 15,255,240,15,255,240,15,255,2
40                                              JD
•2480 REM - SPRITE 4                            NF
•2490 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2500 DATA 31,255,248,31,255,248,31,255,2
48                                              IJ
•2510 REM - SPRITE 5                            NE
•2520 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2530 DATA 63,255,252,63,255,252,63,255,2
52                                              AB
•2540 REM - SPRITE 6                            NL
•2550 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2560 DATA 127,255,254,127,255,254,127,25
5,254                                           AF
•2570 REM - SPRITE 7                            NK
•2580 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,                        MH
•2590 DATA 255,255,255,255,255,255,255,25
5,255                                           NI
```

COMMODARES

Continued from page 84

is meaningless. Jim's solution checked for proper syntax as it evaluated the input. That makes the problem quite a bit tougher. We'll leave that as an additional challenge for those of you who found this one too easy.

The follow people who haven't been mentioned earlier also sent solutions to February *Commodares:* Donald H. Graham (Baltimore, MD), Paul Sturm (Weatherford, TX), Jesus Geliga-Torres (Aguadilla, PR), Dan R. King (High Rolls, NM), Thomas Lambert (Severna Park, MD), Richard Balliet (Nuangola, PA), Glenn Elliot (Rutherford, NJ), Robert Lackey (Albuquerque, NM), Jack Thompson (Kirkwood, MO), Bruce Landrum (Fayetteville, AR), Dex Peterson (LeRoy, MI), Royce Crabtree (Madisonville, KY), and Aaron Hughart (Pocatello, ID).

Once again, these are the people whose solutions to February's *Commodares* have reached us by the middle of February. Put on those thinking caps and get busy on this month's challenges. You've got a lot of work to do! □

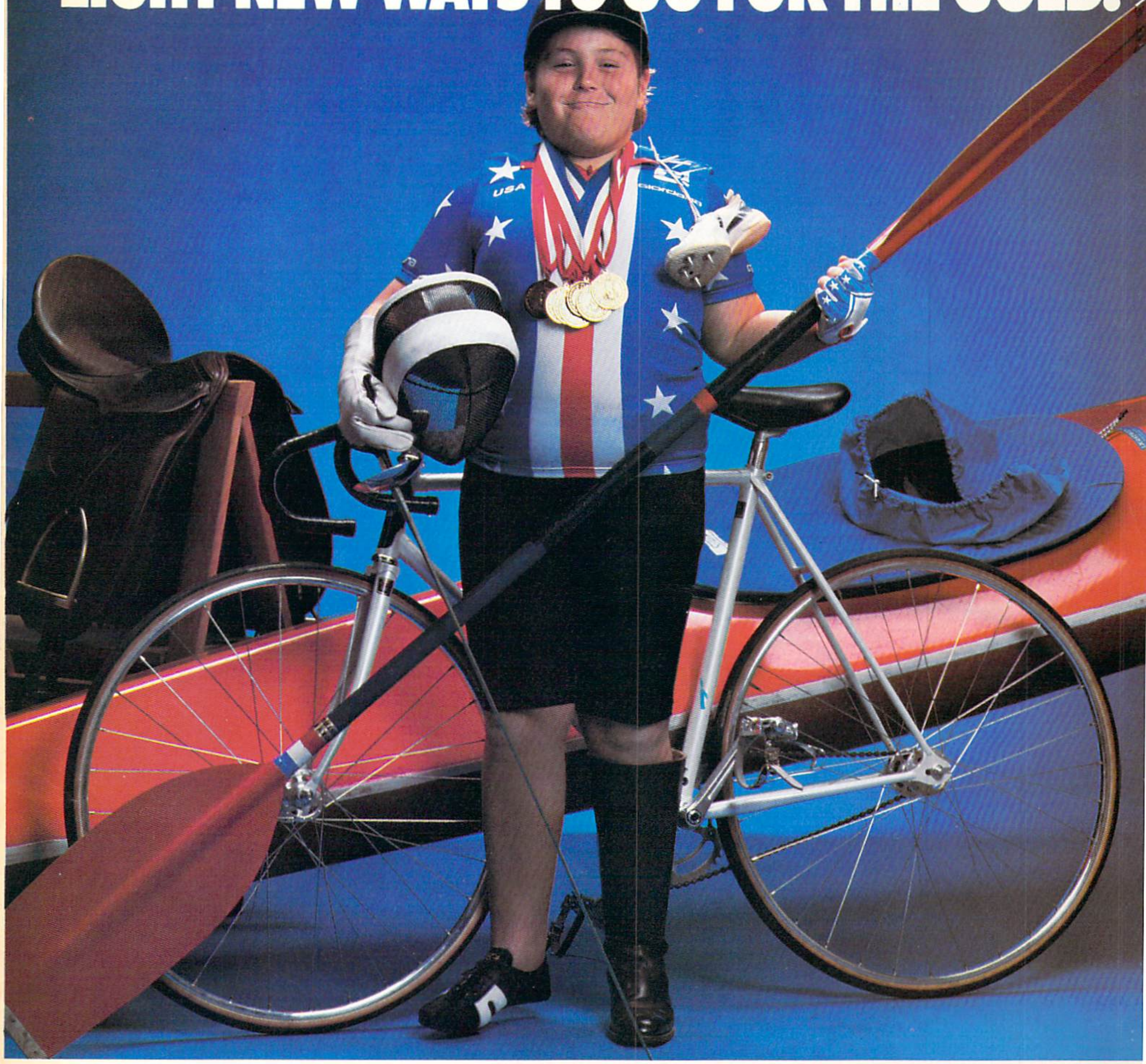
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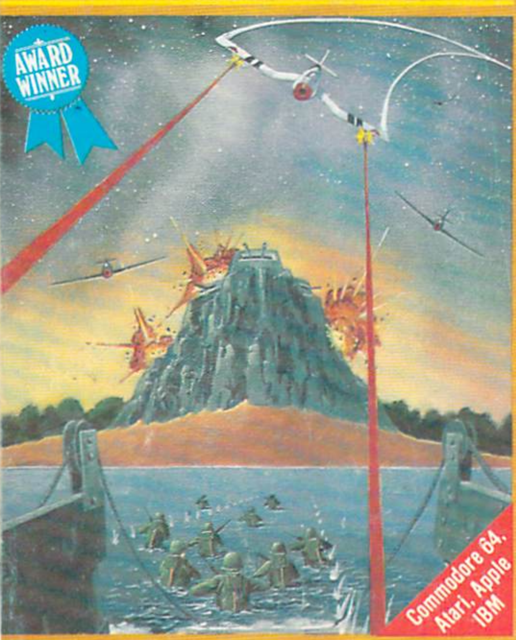
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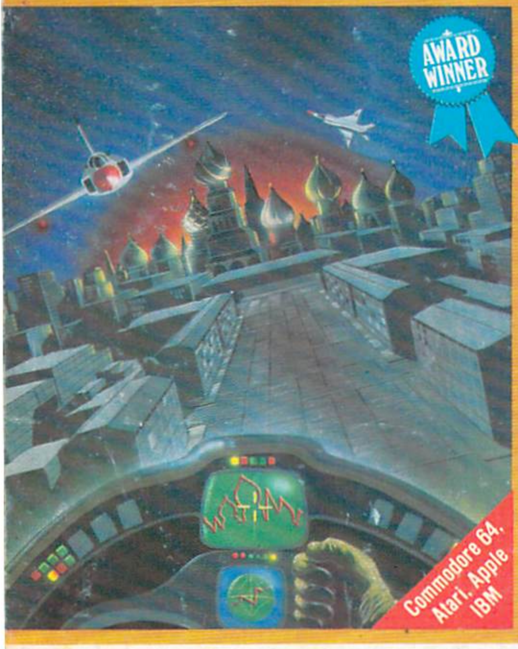


BEACH-HEAD II

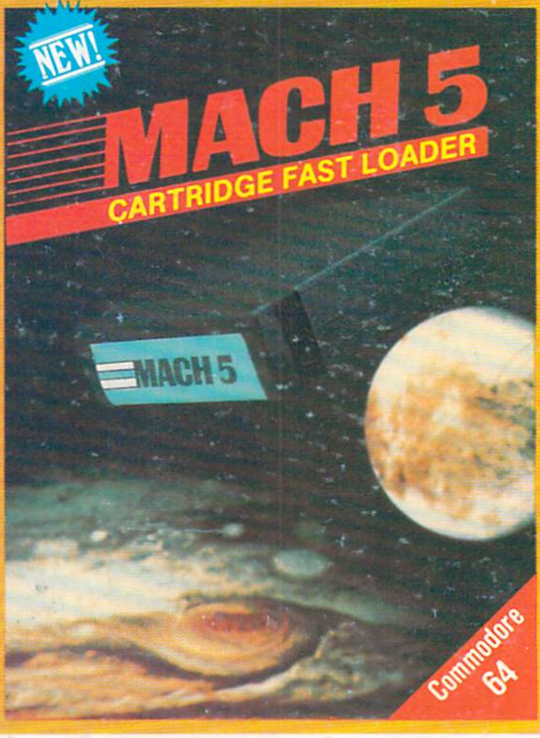




RAID OVER MOSCOW







Mach 5 is a collection of powerful programs that enhance the capabilities of the C-64 with a 1541 disk drive. The package provides up to 500% faster program loading, 4K of additional basic workspace and disk cataloging.

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